

RADIOLOGY

A MONTHLY JOURNAL DEVOTED TO CLINICAL RADIOLOGY AND ALLIED SCIENCES

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CONTENTS

ANOMALOUS PULMONARY VENOUS DRAINAGE INTO THE LEFT VERTICAL VEIN.	<i>Bertram Levin, M.D., and Craig W. Borden, M.D.</i>	317
THE RADIOLOGIST'S RESPONSIBILITY IN PULMONARY RESECTION.	<i>Carl C. Birkelo, M.D., Perry C. Martineau, M.D., and Frank H. Voelz, M.D.</i>	325
UNUSUAL ROENTGEN MANIFESTATIONS OF PATENT DUCTUS ARTERIOSUS.	<i>Alexander R. Margulis, M.D., Melvin M. Figley, M.D., and Aaron M. Stern, M.D.</i>	334
NON-TRAUMATIC PNEUMOPERICARDIUM AND PYO-PNEUMOPERICARDIUM. REPORT OF TWO CASES.	<i>Paul M. Dassel, M.D., and Israel E. Kirsh, M.D.</i>	346
TREATMENT OF RARE LESIONS OF THE UTERUS AND VAGINA.	<i>Robert E. Fricke, M.D., Martin Van Herik, M.D., and Edward H. Soule, M.D.</i>	353
A TOPOGRAPHIC APPROACH TO THE ROENTGENOLOGIC AND PATHOLOGIC EXAMINATION OF THE LARYNGOPHARYNGEAL TUMORS.	<i>Gilbert H. Fletcher, M.D., Jacob W. Old, M.D., and George S. Loquvam, M.D.</i>	361
THE CALCULATION OF ROTATION THERAPY TUMOR DOSES AT 250 KV. BY MEANS OF THE TRANSMITTED DOSE RATE.	<i>Robert Robbins, M.D., and Jean Meszaros, M.S.</i>	381
RADIOGOLD SEEDS IN CLINICAL RADIATION THERAPY.	<i>Ulrich K. Henschke, M.D., Ph.D., Arthur G. James, M.D., and William G. Myers, Ph.D., M.D.</i>	390
RADIATION HAZARDS IN THE PRACTICE OF RADIOLOGY.	<i>Charles M. Barrett, M.D.</i>	400
TOMOGRAPHIC ASPECT OF PARALYSIS OF THE VOCAL CORDS.	<i>Roberto Calderon, M.D., Jorge Ceballos, M.D., and John P. McGraw, M.D.</i>	407
ROENTGEN FINDINGS IN A CASE OF PERFORATION OF THE CECUM BY A BONE.	<i>Isadore Katz, M.D., and Joseph Arcomano, M.D.</i>	411
EDITORIALS: THE RADIOLOGICAL SOCIETY OF NORTH AMERICA. AN INVITATION TO THE ANNUAL MEETING.	<i>Eugene P. Pendergrass, M.D.</i>	415
THE RADIOLOGIST IN THE SMALL COMMUNITY.	<i>Christian V. Cimmino, M.D.</i>	416
REFRESHER COURSE OUTLINE.		418
ANNOUNCEMENTS AND BOOK REVIEWS.		428
RADIOLOGICAL SOCIETIES: SECRETARIES AND MEETING DATES.		433
ABSTRACTS OF CURRENT LITERATURE.		437

RADIOLOGY

A MONTHLY PUBLICATION DEVOTED TO CLINICAL RADIOLOGY AND ALLIED SCIENCES

PUBLISHED BY THE RADIOLOGICAL SOCIETY OF NORTH AMERICA

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Anomalous Pulmonary Venous Drainage into the Left Vertical Vein¹

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ANOMALIES of pulmonary venous return are being recognized with increasing frequency and in the past fifteen years have been the subject of well over a score of papers. These have, for the most part, been anatomic studies, but in the last few years a number of reports have been devoted to the clinical aspects of this cardiovascular anomaly. Pulmonary veins have been found to drain anomalously into the superior vena cava, the coronary sinus, the portal vein, the right atrium, the innominate veins, the sinus venosus, the azygos vein, and even the thoracic duct (14). All or part of the pulmonary venous blood may be diverted from the left atrium into systemic veins.

One of the more frequent aberrations of pulmonary venous return is the emptying of the pulmonary veins into a left vertical vein (14). The latter is a wide vertical vascular structure to the left of and adjacent to the base of the heart, linking the pulmonary veins with the left innominate vein. The course of the circulation is shown in Figure 1. There is much divergence of opinion concerning the development of this anomalous vessel and its communications. Some authorities attribute

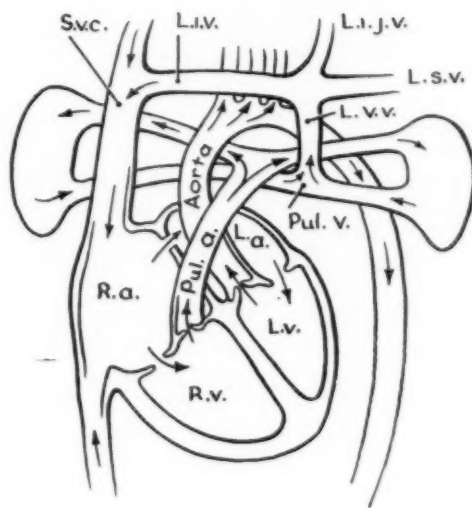


Fig. 1. Course of circulation in complete anomalous pulmonary venous drainage into the left vertical vein. L. V. V. Left vertical vein. L. S. V. Left subclavian vein. L. I. J. V. Left innominate vein. S. V. C. Superior vena cava. Pul. A. Pulmonary artery. Pul. V. Pulmonary veins. The only blood received by the left side of the heart is through a defect in the interatrial septum.

it to retention of one or the other of the original communications between the pre-splanchnic plexus and pulmonary anlage (3, 5, 6, 15). Another opinion is that it is

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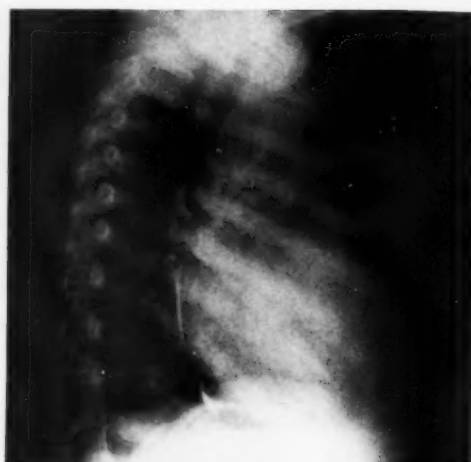


Fig. 2. Case I. Complete anomalous pulmonary venous drainage into the left vertical vein. The superior mediastinum is widened bilaterally. On the right this is due to the dilated superior vena cava; on the left, to the left vertical vein. The cardiac enlargement is confined to the right chambers. The pulmonary vascular markings are exaggerated throughout both lung fields.

due to failure of the pulmonary veins to communicate primarily with the heart, leading to free communication between the pulmonary and systemic veins (7). Others feel that from the present state of knowledge there is no rationale for the anomaly (10, 12).

Previous authors have referred to the left vertical vein as a persistent left superior vena cava. This designation is probably incorrect, since the structure has no communication with the coronary sinus and lies anterior to the position of a true left superior vena cava. Cases of true left superior vena cava, with and without a companion right superior vena cava, have been described (19, 20, 25). These represent persistence of the left precardinal vein communicating directly with the coronary sinus. Normally, the left precardinal vein loses its communication with the left common cardinal vein (which persists as the coronary sinus) and remains only as the left superior intercostal vein (1, 22). Snellen and Albers (23) were the first to refer to the structure in question as a left vertical vein.

The purpose of this report, based on 4 cases of anomalous drainage of the pulmonary veins into the left vertical vein, is to call attention to the highly characteristic

roentgenologic features of this cardiovascular anomaly. It is of practical importance that such cases be recognized, since there is reason to believe that some of them may be amenable to surgical correction. To the authors' knowledge, there has been no report on this entity in English roentgenologic literature.

CASE REPORTS

CASE I: A boy of 3 1/2 years was admitted to the hospital on June 18, 1951, because of congestive heart failure. He had exhibited transient cyanosis following delivery by internal podalic version. During infancy he was mildly dyspneic and occasionally vomited after moderate exercise. At the age of eighteen months he had a "breath-holding spell" which resulted in cyanosis and unconsciousness. At that time a diagnosis of congenital heart disease was made. Following this, dyspnea progressed and cyanosis on exertion became evident. Eyelid and ankle edema developed about a month before admission.

Physical examination revealed minimal cyanosis of the lips and nails and generalized anasarca. The blood pressure was 110/70 mm. Hg. The heart was enlarged, and there were a systolic thrill and rough systolic murmur over the left third interspace. A Grade I diastolic murmur was present over the same area. The second pulmonic sound was louder than the aortic. There was moderate hepatomegaly. An electrocardiogram showed right axis deviation (plus 110 degrees) and high-peaked P waves. The blood hemoglobin concentration was 15 gm. per 100 c.c.

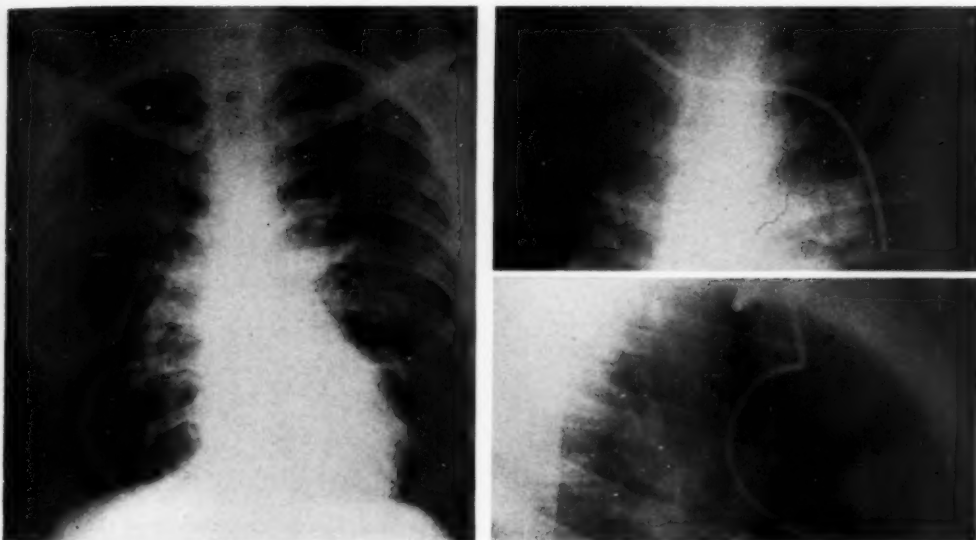


Fig. 3. Case II. Partial anomalous pulmonary venous drainage into the left vertical vein. Widening of the base of the heart is most evident on the left (left vertical vein). There is no obvious distention of the superior vena cava. The pulmonary vascular markings are prominent. The views on the right show the catheter in the left vertical vein.

Fluoroscopy and roentgenography revealed marked cardiac enlargement, which was predominantly right ventricular, and exaggerated pulmonary vascular markings. Superior mediastinal widening to the right and left (Fig. 2) was variously interpreted as representing a cystic mass or unusual thymus shadow.

The patient responded poorly to the usual treatment for congestive failure and expired with terminal pneumonitis on July 8, 1951.

At postmortem examination the superior vena cava and the innominate veins were found to be tremendously dilated. All pulmonary veins emptied into an anomalous vessel joining the left innominate vein and lying anterior to the pulmonary artery. There was no communication between the pulmonary veins and the left atrium. The right atrium and ventricle were greatly dilated; the left atrium and ventricle were small. The foramen ovale was approximately 1 cm. in diameter and patent, but no other septal defect was present. The ductus arteriosus was obliterated. The pulmonary artery and all the heart valves were normal. The thymus was not enlarged.

CASE II: A 22-year-old man was referred to the Heart Hospital on June 11, 1951, for cardiac evaluation because of a heart murmur which had been discovered on a draft board examination. Fatigue and dyspnea on moderate exertion had been present for seven years but had not prevented the patient from working as a farm laborer. He had never been cyanotic.

Physical examination revealed a blood pressure

of 110/70 mm. Hg. The heart was slightly enlarged, the point of maximal impulse being 2 cm. beyond the mid-clavicular line. A blowing systolic murmur of Grade II intensity was present along the left sternal border. Electrocardiographic tracings showed an electrical axis of plus 110 degrees with a pattern of right ventricular strain. The hemoglobin concentration of the blood was 16.4 gm. per 100 c.c.

Roentgen examination revealed widening of the base of the heart to the left by what appeared to be a wide vertical vascular structure above the aortic arch (Fig. 3). The bronchovascular markings were exaggerated; no unusual pulsations were observed. There was moderate right-sided cardiac enlargement.

Data obtained from cardiac catheterization are included in Table I. At the first examination, using the left antecubital vein, a high oxygen saturation was found in the specimen of blood taken from the superior vena cava. Pressures in the pulmonary artery and right ventricle were slightly elevated. At the second examination the catheter was inserted into a vein of the right arm. It was introduced past the superior vena cava into the left innominate vein and then into the left vertical vein (Fig. 3). At that site fully oxygenated blood was obtained, proving the presence of pulmonary venous drainage into the left vertical vein. The catheter could not be passed beyond this structure to determine if both lungs were anomalously drained, nor could it be passed through a septal defect when the right atrium was subsequently explored. The calculated shunt from left to right, *via* the left vertical vein, was

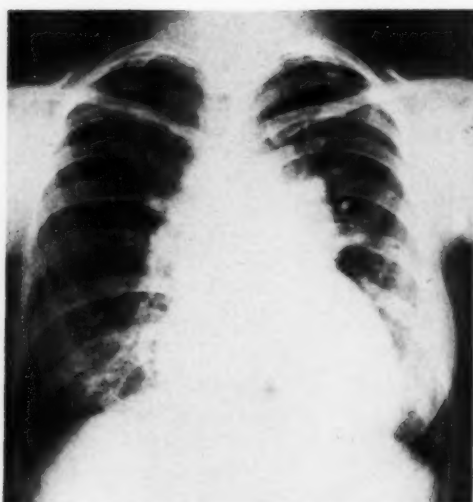


Fig. 4. Case III. Complete anomalous pulmonary venous drainage into the left vertical vein. The widening of the base of the heart is most prominent on the left (left vertical vein), with only slight distention of the superior vena cava. There is moderate exaggeration of the pulmonary markings.

TABLE I: DATA OBTAINED BY CARDIAC CATHETERIZATION

	Case II Feb. 6, '52	Case II Feb. 14, '52	Case III March 18, '52	Case IV Jan. 12, '53
Blood Oxygen Saturation (percent)*				
Pulmonary artery	79	..	90	91
Right ventricle	86	91
Right atrium	85	91	92	92
Superior vena cava	90	89	91	94
Left vertical vein	..	93	94	..
Right innominate vein	..	68	77	68†
Inferior vena cava	..	83	76	..
Femoral artery	96	94	87	91
Pressures (mm. Hg)				
Pulmonary artery (mean)	25	..	46/15	32/13
Right ventricle	35/0	..	109/0	78/6
Right atrium (mean)	0	..	5	3

* No correction has been made for physically dissolved oxygen.

† Left innominate vein distal to insertion of the left vertical vein.

approximately 9 liters per minute. The peripheral arterial oxygen saturation was normal.

CASE III: A 32-year-old housewife was admitted to the hospital on March 16, 1952, for exact diagnosis of a congenital heart lesion. She had been



mildly cyanotic and dyspneic since birth but was otherwise asymptomatic. She had gone through pregnancy and delivered a normal infant without difficulty in 1946. At the age of twenty-seven she began to have severe paroxysms of rapid heart action which were precipitated by anxiety and emotional upsets and ceased spontaneously in about fifteen minutes.

Examination revealed very slight cyanosis of the lips and nailbeds. The blood pressure was 110/70 mm. Hg. The heart was enlarged to the anterior axillary line and gave a diffuse precordial wave. A Grade IV systolic murmur and thrill were present in the third left interspace. The second pulmonic sound was louder than the second aortic. The electrocardiogram revealed right axis deviation (plus 100 degrees) and right ventricular strain. The blood hemoglobin concentration was 15.6 gm. per 100 c.c.

Roentgen examination revealed right-sided cardiac enlargement, a prominent pulmonary artery segment, and widening of the base of the heart to the left. The postero-anterior roentgenogram is shown in Figure 4.

Cardiac catheterization was performed on March 18, 1952 (Table I). The pulmonary artery was entered from the left arm approach. A diagnosis of pulmonic stenosis and left-to-right shunt was established. The catheter was then inserted into a right arm vein and the left vertical vein was explored. The catheter was passed into both right and left pulmonary veins, establishing communication of the left vertical vein with both lungs. Near the end of the procedure supraventricular tachycardia developed, with a rate of 280 per minute. The electrocardiogram showed auricular flutter

Fig. 5. Vertical roentgenogram showing right-sided cardiac enlargement and a prominent pulmonary artery segment.

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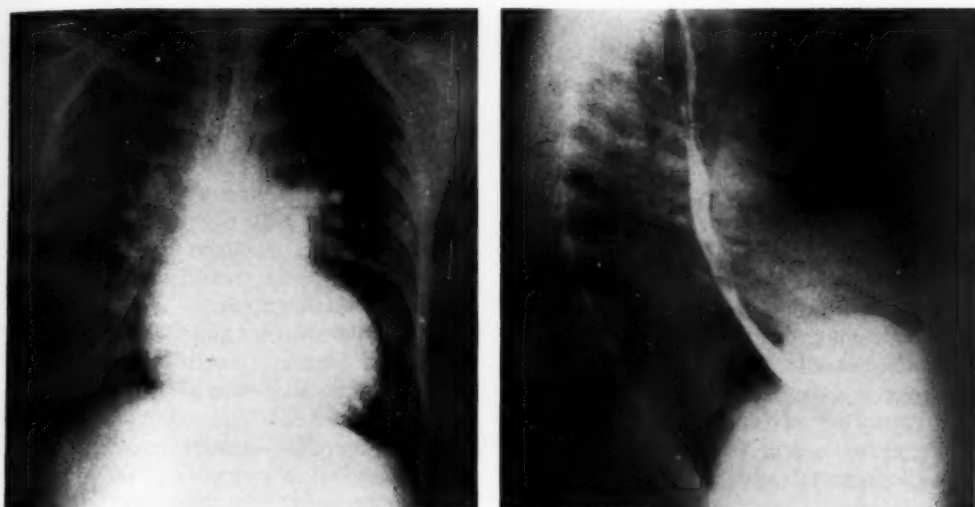


Fig. 5. Case IV. Complete anomalous pulmonary venous drainage into the left vertical vein. The left vertical vein, the distended superior vena cava, and the enlarged heart form the contour of a figure 8. The right-sided cardiac enlargement and the prominence of the pulmonary artery segment and branch pulmonary arteries are well demonstrated.

with a 1:1 block, changing to a 4:1 block. There was a return to normal sinus rhythm in thirty minutes.

The patient became pregnant for the second time in August 1952. She got along well until the fifth month, when frank congestive failure developed. Premature delivery followed one month later.

A transient episode of congestive failure occurred in April 1953. In May 1953, episodes of severe paroxysmal tachycardia became frequent and were associated with fever. A culture of the blood yielded *Streptococcus faecalis*, and therapy for subacute bacterial endocarditis was instituted. Recovery was uneventful.

CASE IV: A 16-year-old schoolboy was referred to the Heart Hospital on Jan. 7, 1952, for definitive diagnosis. He gave a history of cyanosis at birth, but this later disappeared. In early childhood he had some difficulty in keeping up with his contemporaries because of dyspnea and he became slightly cyanotic after moderate exertion. A routine examination at the age of twelve revealed a cardiac murmur. Palpitation and increasing exertional dyspnea had developed over the past two years.

Physical examination at the time of admission revealed poor development and mild cyanosis. There was moderate clubbing of the fingertips. The heart was enlarged to the anterior axillary line. A harsh Grade III systolic murmur was present along the left sternal border in the third and fourth intercostal spaces. The second pulmonic sound was louder than the aortic. The blood pressure was 105/70 mm. Hg. The electrocardiogram revealed

right ventricular strain with an electrical axis of plus 100 degrees. The hemoglobin concentration of the blood was 17.6 gm. per 100 c.c.

Roentgen examination showed widening of the base of the heart, both to the right and left (Fig. 5). The pulmonary artery segment was prominent, as were the hilar and peripheral pulmonary markings. Moderate right-sided cardiac enlargement was present. A roentgen diagnosis of a left vertical vein with anomalous insertion of pulmonary veins was made.

Cardiac catheterization was performed to establish the diagnosis (Table I). Blood with an arterial oxygen content was obtained from the superior vena cava at its junction with the left innominate vein. Systemic venous blood was obtained distal to the insertion of the left vertical vein. Blood from the femoral artery was unsaturated, a value of 87 per cent being obtained. Systolic pressure in the right ventricle was distinctly higher than that in the pulmonary artery, leading to a diagnosis of pulmonic stenosis.

Angiocardiography was attempted twice by injecting 40 c.c. of 70 per cent Diodrast into the left median basilic vein. On both occasions the contrast medium was visualized in the left subclavian vein and in a short portion of the left vertical vein. At this point the density of the medium faded markedly, although a greatly dilated left innominate vein leading to the superior vena cava was faintly opacified. This was apparently due to dilution of the Diodrast solution by the large volume of blood from the pulmonary veins added to the normal flow in the innominate vein.

ROENTGENOLOGIC FEATURES

The similarity of the roentgenographic appearances in the 4 cases presented is striking. In reports of 10 other cases of anomalous return of pulmonary veins into the left vertical vein the chest roentgenograms were reproduced (13, 16, 17, 21, 23, 24). In each case the cardiac silhouette bore the same appearance, which has been previously likened to a figure 8 (23). The upper loop of the 8 is formed by the dilated superior vena cava and by the left vertical vein; the lower loop is formed by the heart. The roentgen picture is probably more specific than that of tetralogy of Fallot, the shelf appearance of truncus arteriosus, or the disproportionate pulmonary artery shadows of pulmonary valvular stenosis.

In the postero-anterior projection, the prominent feature is the superior mediastinal widening, the upper loop of the figure 8 as noted above. In none of the 4 cases of this series was there evidence of more than faint pulsation of the vena cava or left vertical vein. Since the return of blood to the left side of the heart is not increased, the left cardiac chambers are relatively small as compared to the right. The right ventricle is greatly enlarged, the degree of enlargement depending on the volume of left-to-right shunt and the absence or presence of pulmonic stenosis. The hilar and peripheral pulmonary arteries are dilated because of the increased pulmonary blood flow.

Many mediastinal lesions could conceivably simulate dilatation of the superior vena cava and the left vertical vein. Aneurysm of the aortic arch merits consideration but usually occurs in an older age group and is not accompanied by pure right-sided cardiac enlargement. Thymic enlargement must be differentiated, especially in infants, but in none of the reported cases did the mediastinal widening extend upward into the neck, as is characteristic of diffuse thymic enlargement. Substernal thyroid enlargement, thymoma, and parathyroid tumor, as well as dermoid and bronchogenic cysts, generally produce mediastinal widening to one side and may

cause tracheal or esophageal displacement. Such displacement has not been noted in any of the reported cases of pulmonary venous return into the left vertical vein. Adenopathy may produce superior mediastinal widening, but this is usually accompanied by hilar adenopathy and is not confined anteriorly. If congenital heart disease is suspected and the figure-8 contour is recognized, there should be no difficulty in differential diagnosis.

Angiocardiography may be a useful diagnostic procedure. Generally, the superior vena cava opacifies soon after the injection of the contrast medium. The left vertical vein then opacifies simultaneously with the pulmonary veins and later reopacifies, indicating recirculation of contrast medium through the lungs with drainage into the left vertical vein. Angiographic study may not only visualize and identify the left vertical vein but may also give evidence of a large shunt into the innominate vein and superior vena cava. This was demonstrated in Case IV, in which dilution of the contrast medium by the large volume of blood from the pulmonary veins prevented visualization of the superior vena cava. Grishman and associates (13) report a similar finding.

CLINICAL FEATURES

It has been pointed out previously that when anomalous pulmonary venous return is only partial, and there are no major intracardiac abnormalities, few symptoms beyond mild exertional dyspnea are produced (16, 23, 24). The anomalous vessel may be unsuspected and discovered at thoracotomy (4, 9, 18). If, however, an appreciable volume of blood is shunted through an anomalous pulmonary vein from left to right, a natural history similar to that of interatrial septal defect can be anticipated (2). The shunt increases the work of the right ventricle (8). Pulmonary hypertension may develop to increase right ventricular hypertrophy and hasten the onset of right ventricular failure. The coexistence of an atrial septal defect with a left-to-right shunt and anomalous pulmo-

nary venous drainage into the right atrium poses obvious diagnostic difficulties (11). Although an atrial septal defect was not excluded in Case II, the estimated shunt through the left vertical vein itself could account for the clinical findings. The symptoms were mild, arterial oxygen saturation was normal, and right ventricular hypertrophy moderate. The shunt was of sufficient magnitude, however, to enable one to make a reasonable prediction of eventual progression of symptoms.

In contrast to the situation existing in Case II, patients with complete anomalous pulmonary venous drainage who survive childhood exhibit disabling symptoms by the second or third decade, as illustrated by Cases III and IV. Dyspnea and cyanosis are invariably present. Although the latter is usually mild, its presence suggests the diagnosis of congenital heart disease. Paroxysms of supraventricular tachycardia and palpitation have received comment before (23). They occurred frequently in Case III. A very loud (Grade IV) systolic murmur accompanied by a thrill along the left sternal border suggests an associated pulmonic stenosis. This sign is not pathognomonic (8), however, as illustrated by Case I, in which a thrill was present without stenosis. In Case IV, on the other hand, a thrill was absent and pulmonic stenosis was present. Polycythemia is absent or mild, although arterial oxygen saturation is slightly but definitely lowered. The electrocardiogram shows severe right axis deviation and a pattern of right ventricular strain. These clinical findings are not specific, but in conjunction with the typical radiologic picture they permit an accurate diagnosis to be made.

Definitive diagnosis requires cardiac catheterization to obtain blood with a high oxygen saturation from the left vertical vein or at its junction with the innominate vein. The left vertical vein is best entered by passing the catheter from the right arm rather than from the left. The structure can then be explored with the catheter and it may be possible to demonstrate communication with right and left pulmonary

veins (Case III). Difficulty in passing the catheter beyond the vertical vein into a pulmonary vein is probably due to the acute angle formed at the junction of the two vessels. To confirm or exclude the presence of pulmonic stenosis, it is necessary to determine pressures in the pulmonary artery and right ventricle. From the data for Cases III and IV (Table I) and those reported by others (16, 23), the stenosis appears to be of low grade, inasmuch as the gradient of pressure across the valve is less than that frequently found in congenital pulmonic stenosis.

In no instance was the presence of an atrial septal defect proved at cardiac catheterization. This can be done only by passing the catheter from right to left through the defect and obtaining left ventricular pulse pressure curves. The course of the catheter as visualized fluoroscopically can be misleading. Nevertheless, the presence of a large atrial defect with admixture of venous and "arterialized" blood can be surmised by finding a similar oxygen content in blood samples from the pulmonary and femoral arteries, as in Cases III and IV. Where there is complete anomalous pulmonary venous return, systemic oxygenation can be maintained only by a compensatory shunt from right to left, most frequently through a large interatrial defect (5, 23, 24). Partially oxygenated blood may also reach the systemic circuit by way of a ventricular septal defect, or rarely through a patent ductus arteriosus from pulmonary artery to aorta. As illustrated by Case I, death will occur soon after obliteration of the ductus arteriosus if no large septal defect exists, the amount of flow through the small orifice of a patent foramen ovale (1 cm. in diameter) being insufficient to maintain life.

SUMMARY AND CONCLUSION

Four cases of anomalous pulmonary venous return into the left innominate vein *via* the left vertical vein are reported. One was proved at autopsy and the others by cardiac catheterization. There is a striking similarity in the roentgenographic

appearance of the heart and great vessels in these cases, as well as in 10 other cases reported in the literature. This appearance is considered to be highly characteristic of this cardiovascular anomaly.

NOTE: Since this paper was completed, 4 more cases of similar anomalous drainage of the pulmonary veins have been reported by Gardner and Oram (Persistent Left Superior Vena Cava Draining the Pulmonary Veins. *Brit. Heart J.* 15: 305-318, 1953). The clinical data and the roentgenographic appearances are in accord with the cases in the present series.

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SUMARIO

Canalización Venosa Pulmonar Anómala a la Vena Vertical Izquierda

Preséntanse 4 casos de retorno venoso pulmonar anómalo al tronco venoso braquiocefálico izquierdo por vía de la vena vertical izquierda. Uno fué comprobado en la autopsia y en los otros demostró el fenómeno el cateterismo cardíaco. En estos casos, así como en otros 10 descritos en la literatura, existe una notable semejanza

en el aspecto roentgenográfico del corazón y de los grandes vasos. Dicho aspecto se considera sumamente típico de esa anomalía cardiovascular. La silueta cardíaca toma la forma de un número 8, cuya asa superior está formada por la cava superior dilatada y la vena vertical izquierda y la inferior por el corazón.

The Radiologist's Responsibility in Pulmonary Resection¹

CARL C. BIRKELO, M.D., PERRY C. MARTINEAU, M.D., and FRANK H. VOELZ, M.D.

THIS STUDY is a correlation of radiological, surgical, and pathological findings provided by pulmonary resections of tuberculous lesions. We believe that it could apply equally well to non-tuberculous lesions requiring similar treatment. By such correlation we hope to demonstrate the importance of the radiologist's opinion and his responsibility in resections of the lung.

In the past, as well as in the foreseeable future, we must assume that the radiologist is a consultant both to the internist and to the surgeon concerned with managing or treating tuberculous disease. In view of this assumption, a short summary of objectives in each of these fields may be pertinent.

Three primary objectives of treatment in tuberculosis may be expressed as follows: (1) closure of cavities; (2) conversion of sputum to negative; (3) stabilization of tuberculous infiltrations. These objectives have been the same down through the ages; yet chemotherapy has so greatly changed the results of treatment that special mention of its effects is worth while.

Chemotherapy at first was limited to streptomycin given alone. It was found, however, that resistance to the drug developed in 80 to 90 per cent of cases. It later appeared that by combining streptomycin with other drugs, such as para-Aminosalicylic acid and Isoniazid, this resistance could be avoided in most instances. Our present chemotherapeutic program usually involves combinations of these drugs given for many months without significant interruption, in order to obtain the maximum benefit. Under chemotherapy, the following results may be observed.

In far advanced tuberculous disease we often find bilateral tuberculous infiltrations

extending through large areas of both lungs. During chemotherapy we usually observe rapid resolution of such infiltrations, so that all of the lesions may disappear from view except for a varying number of small residuals. As resolution occurs, linear strands of scar tissue may appear and remain as the only evidence of former disease. Other infiltrates may fail to clear completely, leaving residuals in the form of nodules or fairly well circumscribed lesions. These may persist or may show very slight clearing over many months. Such residual, nodular lesions may be considered for surgical removal, especially if there is any question of cavity or if, occasionally, the sputum should remain positive.

During chemotherapy, the majority of cavities will close in six to eight months. They may gradually decrease in size and slowly fade out completely. Occasionally, they fail to change in size but the cavity wall is observed to thin out gradually, becoming almost of onion-skin thickness. When this happens, large cavities come to resemble emphysematous blebs. Still another type of cavity may at first become smaller, then fill with fluid, and later discharge its contents and reappear.

Sputum conversion from positive to negative during chemotherapy is very common and occurs even in the presence of demonstrable cavitation. We cannot rely on a negative sputum alone as a sign of inactive disease.

Indications for surgical interference are indefinite and may vary in different places. The general idea is to remove such remnants of the disease as do not yield to chemotherapy and are considered possible sources for future reactivation of tuberculosis. At present we are concerned mainly with removing (1) open cavities or question-

¹ From Herman Kiefer Hospital and Wayne University College of Medicine, Detroit, Mich. Presented at the Thirty-ninth Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 13-18, 1953.

able cavities; (2) such lesions as are confined to small areas and are considered dangerous because they show a tendency to change and progress even after prolonged therapy; (3) nodular lesions in cases where a positive diagnosis has not been made.

With these problems in mind, the radiologist's position or responsibility to the internist consists of interpreting the progress of the disease, especially as regards closure or persistence of cavities. He should also interpret resolution of infiltrations, pointing out any important residuals and differentiating them, if possible, from scar tissue. To the surgeon his responsibility consists in identifying important lesions and localizing them. Such lesions are, as a rule, sufficiently large to be easily palpable by the surgeon. Their size should be mentioned so that they may be rapidly identified at operation. If several infiltrates are present, this should be mentioned and they should be carefully localized and described. The distribution may be such that all segments of a lobe are involved and lobectomy will then be necessary. Or the lesions may be confined to one segment and, if possible, this can then be removed. If the important residuals are close to the chest wall and are confined to a small area, a wedge resection may accomplish the purpose. In this manner it is now possible to conserve much lung tissue. The more correct we are in our description as well as localization of surgical lesions, the better service we are able to give the patient.

Our method of examination for this study consists of very ordinary procedures, such as chest examination in the usual postero-anterior and right or left lateral positions. During treatment, monthly postero-anterior projections are made to record the progress with chemotherapy. Then, after eight months of treatment, residual disease is studied with stereoscopic projections, lateral roentgenograms, and laminagrams. Occasionally lordotic projections and lateral Bucky films add much to the accurate description and localization of lesions considered important. With stereoscopic pro-

jections, we are often able to show cavities. When these cannot be demonstrated by this means, they are often apparent on laminagrams. The lateral projections are particularly helpful in outlining the anterior segment in the upper lobes and, since this is a large segment, it is important, if possible, to conserve it. For demonstrating lesions in the lower lobes, and especially for localizing them, laminagrams and Bucky lateral projections give the best information.

In order to study the results of our efforts in the diagnosis of important residual lesions, as well as their localization, it is the practice at the hospital from which this report comes to hold a joint conference of the surgical, medical, radiological, and pathological staffs once a week, at which all resected cases are presented in the following manner:

1. A short summary of the significant history is presented, with films showing the behavior of the tuberculous lesion while the patient was in the hospital under treatment.

2. The conference decision as to needed surgery is then stated, and a résumé of the radiologic opinion as to the location of important lesions, with an opinion regarding fibrosis or remnants of healed tuberculous lesions, the absence or presence of cavities, is given.

3. The findings at operation, the reasons for removing certain segments, and the opinion as to the remaining lung are summarized.

The pathologist then shows colored photographs of the gross specimen cut in serial slab sections in the frontal plane, with the segments numbered. The important lesions are pointed out and correlated with the immediate preoperative film. Microscopic sections of the significant lesions are projected on the screen, and the histologic character of the lesions is described.

At the conclusion a decision as to the future treatment and date of release from the hospital is made.

The pathologic studies of the resected

pulmonary tissue were begun for the purpose of serving as a control for the roentgenologic studies. It was soon found, however, that the latter studies had been so extensive and so carefully performed that they were serving as a control upon the former, as well as telling much of the story of the pathologic processes which had taken place prior to surgery. The correlation between the findings of the two departments, as revealed at the weekly conferences, was found to be very good.

We have not previously mentioned the conference which determines in which cases resection shall or shall not be performed. It consists of the entire staff, resident and attending, and the decisions arrived at express a majority opinion. Before surgery is done, the surgical staff reviews all of the patient's records and findings. If discrepancies are found and surgery appears inadvisable, the case must be re-presented before the general conference before final disposition is made. We have in the past few years performed from 150 to 175 resections per year and we have studied intimately all such cases.

THE CLINICIAN'S ROLE

The clinicians know their patients well and have carefully watched their response to treatment. If the process of resolution ceases before complete clearing has occurred, the idea presents itself: what can be done surgically? If there is a question of cavity remaining, the argument for resection is naturally fortified. The clinician then seeks the support of the radiologist and often coerces him into admitting the possibility of cavity, small and indistinct, but still a possibility.

In our institution the clinicians are the most enthusiastic group in favor of resection of residual lesions. Their premise is nearly always justified, consisting in an attempt to return the patient to normal living, free from significant tuberculosis, through removal of the visible residuals of the disease. In their favor it must be stated that they are most persistent in their demand for conserving as much lung

as possible, with removal of only such areas as contain important disease. They have made mistakes, it is true, but they have been good students in evaluating such errors, and the general result has been very creditable.

THE SURGEON'S ROLE

So much technical improvement has developed in pulmonary resection that it is difficult to assess and evaluate possible errors in judgment. At first it was a common practice in surgery to remove an entire lobe even if it contained only a few dangerous lesions, well confined to a small segment. This was particularly true of the right upper lobe. Lately, the surgeons commonly remove segments or wedges from any and all lobes, with good results. The errors which they have made in the past have consisted in removing too much lung. Aside from original technical problems which often resulted in lobectomies, they paid too much attention to palpation of lesions and removed parts of the lung free from significant residuals. It is most encouraging to note that at present they are much more conservative and more appreciative of the radiologist's interpretation of important disease and its localization.

THE RADIOLOGIST'S ROLE

1. *Closure of Cavities:* Most cavities, whether large or small, will close under chemotherapy. There have been many opportunities in resected material to show that they have closed and can no longer be found. Those which fail to close may change in size but their walls become so thin that they resemble emphysematous blebs rather than cavities. It is only by careful comparison with previous films that it is possible to determine that such thin-walled areas of rarefaction are in reality cavities.

2. *Nodular Lesions:* Many nodular lesions are found in chronic tuberculous disease and they contain caseous material. Some appear to represent a walling off process and may remain for long periods after

TABLE I: CRITERIA FOR EXAMINATION OF LUNG TISSUE

1. Identification	9. Scars
2. Dimensions	10. Bronchial changes
3. Weight	11. Lymph nodes
4. Pleural lesions	12. Blood vessels
5. Segments involved	13. Complications
6. Cavities	14. Bacteriologic studies
7. Fibrocaceous lesions	15. Photography
8. Pneumonic areas	

chemotherapy; others result from filled cavities. Since many of these nodules fail to resolve, they have often been resected. They are always found to contain necrotic material, and in this material tubercle bacilli are occasionally present.

3. *Scar Tissue:* By scar tissue we refer to the linear densities which we often find following resolution of tuberculous infiltrates. In the absence of small or large nodules, we believe that such areas are free from active disease and we always state that opinion. This finding is nearly always verified by tissue examination.

Our record in localizing important lesions in lobes and segments of lobes is very good. Our greatest failure occurs in lesions located laterally in the upper lobes at the borderline between segments 2 and 3. This error is relatively unimportant, since dissection of a small portion of such adjacent segments is not difficult.

Contraction of lobes is very common during resolution of tuberculous lesions. This applies especially to areas where there were originally many and large cavities which have closed or became much smaller. If the original films are not available, such contraction may not be noticed. The resulting shadow of such a contracted lobe may resemble and be described as an atelectatic segment. At surgery the true condition is discovered and, if the disease extends beyond the atelectatic lobe, pneumonectomy may be necessary. This has happened a few times in our experience, with the result that no resection was done.

THE PATHOLOGIST'S ROLE

A detailed method of examination for each specimen of pulmonary tissue has been developed. The major criteria are

listed in Table I. The exact identification of the specimen is important. The designation of the lobes, segments, and wedges is obtained from the surgeon for all specimens. In addition, sutures and small metal tags have been found useful for identifying the apex and other anatomical landmarks.

The dimensions and weights of all specimens are carefully recorded. Statistics have been gathered from our material for the normal dimensions and weights for each lobe and segment. Abnormalities in this respect, due to generally contracted lobes and segments and to enlargement as a result of compensatory emphysema and other causes, are noted. We have come to recognize that generalized contraction of the upper lobes tends to produce the greatest decrease in their dimensions in the transverse direction and to pull them in toward the mediastinum. In contrast, widespread disease in the pyramidal-shaped lower lobes, with contracture, produces shortening in the long axis of the body.

Both upper and lower lobes are cut in serial slabs about 1 cm. in thickness and laid in serial sequence for photography and identification and localization of the gross lesions. The lesions are cut fresh and under sterile conditions. The exact location and description of the lesions are then recorded. Of prime importance to the surgeon is a definition of the segments involved so that he can correlate the pathologic findings with his original decision as to the extent of the disease and the desirability of removing the segments that were resected. In spite of the technical difficulties involved, surgeons are attempting to remove only those segments and portions of segments containing residual lesions that have not responded to chemotherapy and to conserve as much functional lung tissue as possible.

After the lesions have been located as to segment, they are identified as to type and are measured and described. There are four principal types: cavities, fibrocaceous lesions, pneumonic areas, and scars.

Cavities are identified as to the character of their walls and as to communication

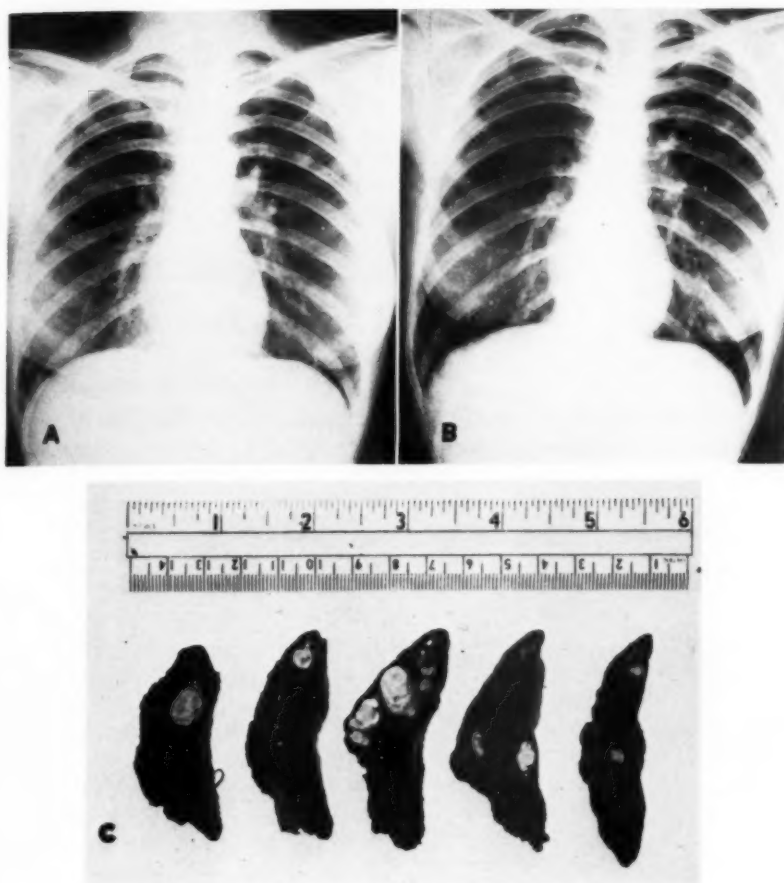


Fig. 1. Case I

- A. May 1, 1951. Large nodules of exudative tuberculosis in the infraclavicular region on the left.
 B. Nov. 17, 1951. Poor response to chemotherapy. Nodules still visible and large. Localization radiologically, segment 2 or 6.
 C. Gross specimen, segment 6, left lower lobe, showing multiple large fibrocaseous lesions measuring up to 1.5 cm. Note thick fibrous walls about the largest lesion.

with the bronchus. Their contents are examined. The fibrocaseous lesions are often well walled off and not too important, but they may represent closed cavities and be potentially dangerous. Areas of tuberculous pneumonia in resected specimens are unusual, as nearly all patients have had at least eight months of antibiotic therapy and most pneumonic processes have been converted into fibrocaseous lesions during that time. Occasionally, in association with a cavity that communicates with a bronchus or in association with a fibrocaseous lesion that has become reactivated

and is spreading through defects in its fibrous wall, areas of tuberculous pneumonia and satellite tubercles are found.

Fibrous scars, both linear and stellate, are described in association with healing or healed lesions and with contracted lobes and segments. In addition to these primary lesions of the lung parenchyma, there are important secondary lesions. The bronchial changes are perhaps the most frequent and striking, including particularly chronic non-specific bronchitis and scarring. Less frequently but more significantly one finds endobronchial tuberculo-

TABLE II: CLASSIFICATION OF PULMONARY RESECTIONS

Right lung.....	8
Right upper lobe.....	90
Right middle lobe.....	8
Right lower lobe.....	12
Right lung segments.....	17
Left lung.....	13
Left upper lobe.....	37
Left lower lobe.....	3
Left lung segments.....	42
Wedges from either lung.....	31
TOTAL.....	261

sis, with or without bronchiectasis and with or without extrinsic or intrinsic causes of obstruction.

The blood vessels are next studied. We have found that in the vicinity of extensive active tuberculous lesions there is always a tuberculous panarteritis. Injection studies of the arterial blood supply of a great many

TABLE III: PULMONARY LESIONS IN RIGHT UPPER LOBE

	Patients
Fibrocaceous lesions.....	86
Cavities.....	18
Pneumonic areas.....	2
Linear scars.....	47
Small contracted lobes with bronchial disease.....	24
Lymph node lesions.....	11
Caseous.....	4

resected lobes at our hospital and by others have shown abrupt terminations of the large vessels as they approach the involved regions.

The lymph nodes both within the lung tissue and at the root of the lung are carefully examined. Caseation is observed in only a minority. Marked enlargement with obstruction of a bronchus is very uncommon and we have not observed fistulous tracts and cavities within the nodes. We believe this to be due to the chemotherapy which precedes surgery. Granulomatous reaction with scarring is the most frequently observed.

Finally, various anomalous structural deformities of the lobes and the presence of any complicating disease process are reported. Bacteriological studies are made of the major lesions. These studies are in a primary stage of development. In the last 207 lung specimens, 195 (94.2 per cent)

showed acid-fast bacilli in the direct smear. We attribute this high percentage to the large amount of pathological material which is submitted to and examined by the bacteriologist. The percentage of positive cultures from these same 207 specimens is only 14.95 per cent. This is in general agreement with other workers who have

TABLE IV: SUMMARY OF RIGHT UPPER LOBE RESECTIONS

Total right upper lobes resected.....	90
Generally contracted (greatest dimension 14 cm. or less.....)	55
Reduced weight (less than 110 gm.).....	18
Pleural adhesions.....	
Generalized.....	21
No adhesions.....	2
Localized adhesions.....	66
Segments involved.....	
All segments.....	55
Segments 1 and 2.....	29
Segment 2 only.....	6
Segment 1 only.....	1
Segments 2 and 3.....	1
Segment 3 only.....	1

been able to show acid-fast bacilli in smears from resected lung tissue but have not been able to grow the organism. About 50 per cent of the positive cultures have shown typical pathogenicity for guinea-pigs. The remainder produced only localized lesions at the point of subcutaneous injection.

Table II shows the localization of 261 resected pulmonary specimens which are representative of over 800 resections of pulmonary tissue performed in this hospital during the past five years. The table shows that resections in the right upper lobe are most frequent and that, while the left upper lobe is almost equally involved by disease, segmental resections are less frequently done and thus more lung tissue is conserved.

Table III gives the frequency of the various types of primary and secondary lesions. Table IV is a summary of right upper lobe resections.

SUMMARY

In summary, we should like to state that the sort of team work described in these pages has been most instructive to all of us. The main reason is that we have before us

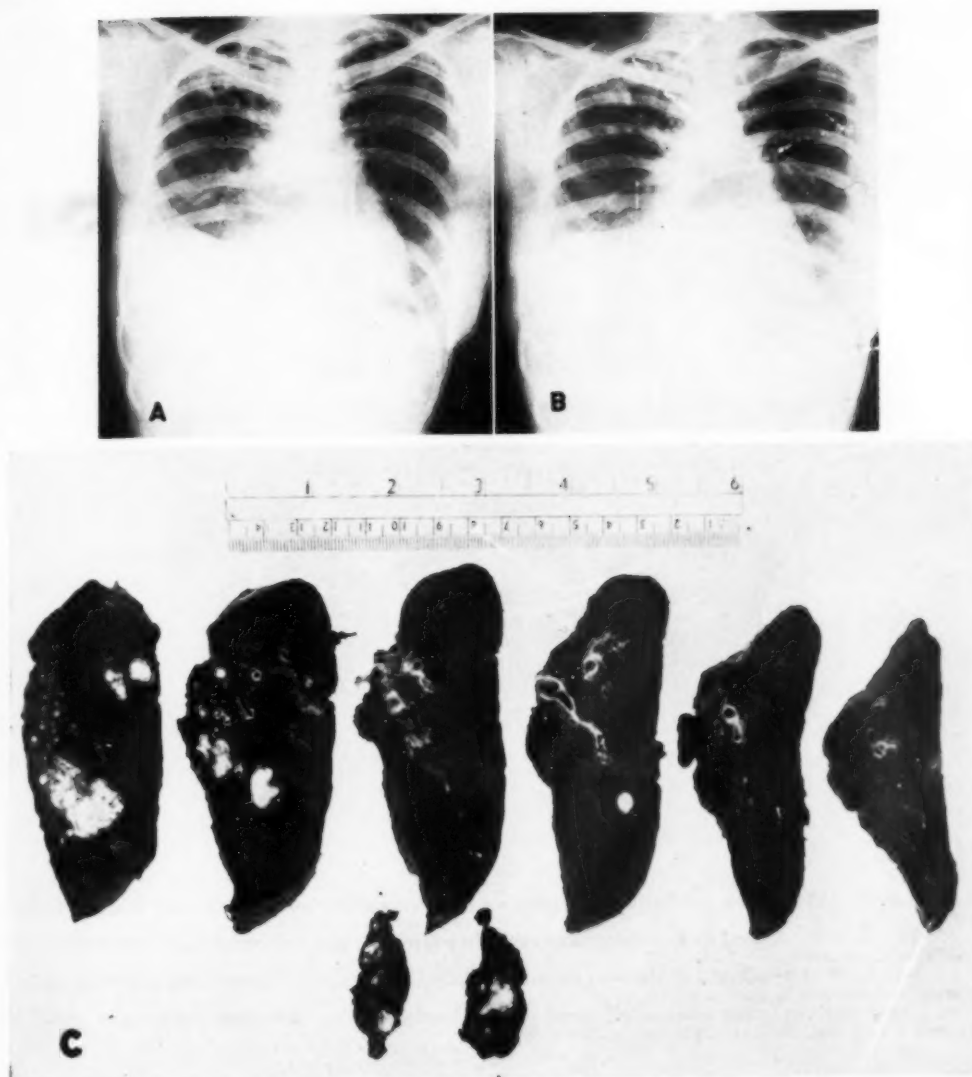


Fig. 2. Case II

A. June 27, 1950. Scattered tuberculosis throughout upper half of right lung, with a large cavity in the upper lobe.

B. July 13, 1951. Large residual nodular lesions, following chemotherapy, scattered through right upper lobe and segment 6.

C. Gross specimen. Right upper lobe and segment 6, right lower lobe, cut in serial slabs in frontal plane. Large fibrocasseous lesions measuring up to 2 cm. in diameter are present in the lower portion of segment 2. Smaller fibrocasseous lesions are noted in the posterior portion of segment 3 and in segment 6.

lesions carefully examined by x-ray before surgery and a chance to see what they actually look like and to know their composition. We also have the patient, with the chance to examine him further, both as regards new lesions or lesions which may

have been palpated and left at the time of surgery.

We are now presenting to the surgical staff a more complete description and localization of lesions under consideration so that they may plan their attack before

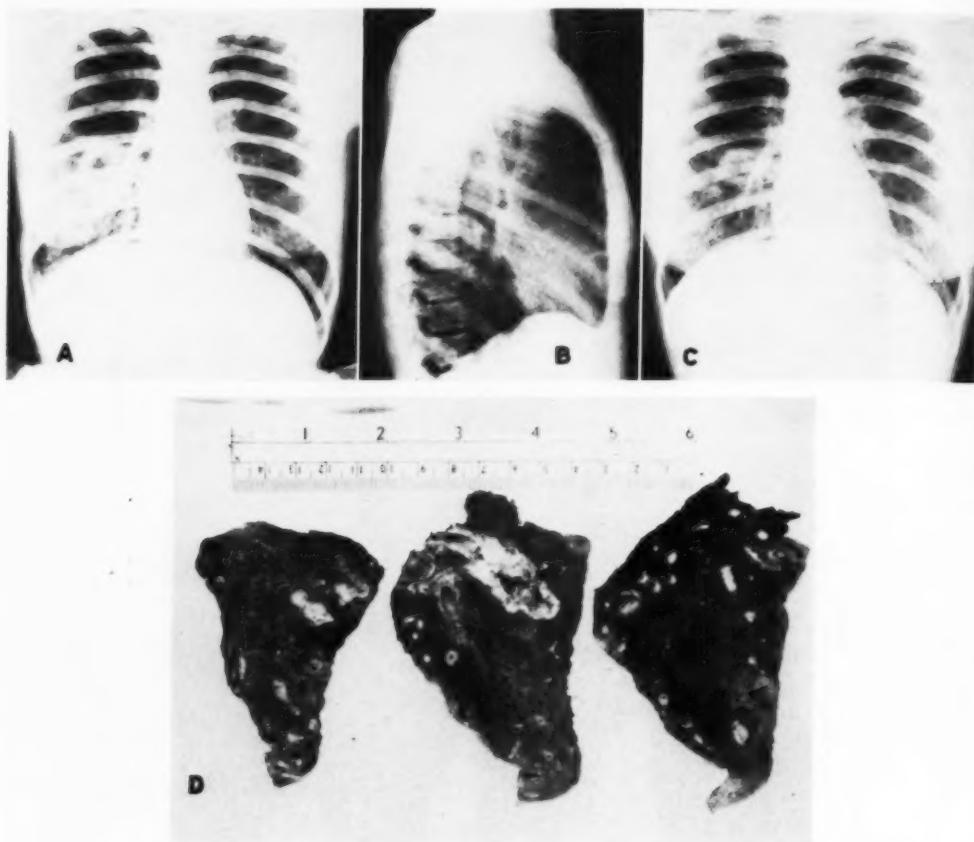


Fig. 3. Case III

A. Aug. 22, 1950. Dense exudative infiltrations scattered throughout lower half of right lung, with large cavity.

B. Sept. 1, 1950. Lateral view, showing large cavity in posterior thorax, and disease scattered through both middle and lower lobes.

C. May 7, 1951. Presurgical film showing marked absorption of infiltration. Cavity is still visible but smaller. Disease now confined to the lower lobe.

D. Gross specimen, right lower lobe. Serial slabs in sagittal plane. Note large thick-walled cavity in segment 6 and small fibrocaceous lesions in all segments.

entering the thorax. If we have presented to them a report that in a certain segment a lesion of certain size and description is to be found, and they do find it, they naturally gain confidence in our report. Such confidence makes their work much easier because they can then follow their planned resections without looking for and expecting to find unrecognized lesions.

To both the radiologist and the internist this experience has been most gratifying, because we now have proof of many former

opinions. Nodular lesions contain caseous material; string-like lesions consist of fibrosis.

The patient has benefited from the resection, we believe, because it has shortened the hospital stay and the questionable remnants of tuberculous disease have been removed.

The pathologist has also profited from this experience by obtaining unusual material, seldom available before, namely healing and healed tuberculous lesions,

sometimes with complications such as findings as well as the pathological changes actually found.

Illustrations of 3 typical cases (Figs. 1-3) show the original and presurgical radiologic

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SUMARIO

La Responsabilidad del Radiólogo en la Resección Pulmonar

En los casos de tuberculosis pulmonar en que se considera la resección, el radiólogo tiene contraída una obligación tanto con el internista como con el cirujano. Su obligación hacia el internista consiste en interpretar la marcha de la enfermedad bajo la quimioterapia en lo tocante a cierre de cavernas, resolución de infiltraciones y presencia de lesiones residuales. Hacia el cirujano, su obligación es identificar y localizar las lesiones importantes como guía del procedimiento operatorio.

En el establecimiento, un hospital municipal grande, del cual procede esta comunicación, se celebra semanalmente una conferencia conjunta del personal quirúrgico, médico, radiológico y patológico, en la cual se repasan todos los casos de resección. Al bosquejar el procedimiento, se recalcan las ventajas de ese estudio cooperativo. Se ha observado buena correlación entre los estudios radiológicos y los histopatológicos.

Tres casos aparecen ilustrados.



Unusual Roentgen Manifestations of Patent Ductus Arteriosus¹

ALEXANDER R. MARGULIS, M.D., MELVIN M. FIGLEY, M.D.,² and AARON M. STERN, M.D.³

IN FEBRUARY 1939, Gross and Hubbard (1) reported the first successful ligation of a patent ductus arteriosus. Subsequent experiences have demonstrated the safety and desirability of the procedure in virtually all patients with this abnormality. Although in the majority of cases the condition can be recognized by physical examination alone, in some instances simple roentgen methods may offer important contributory evidence. In others, additional contrast studies may be required for diagnosis. The 7 cases to be reported here illustrate a number of infrequent and less familiar roentgen features.

PHYSICAL FINDINGS

The characteristic continuous "machinery murmur" in the pulmonary area in an acyanotic individual is the most important diagnostic sign of patent ductus arteriosus. When present, it is virtually pathognomonic of the lesion. The character of the murmur depends on a continuous flow of blood through the patent ductus from the aorta to the pulmonary artery. In infancy (2) and in the presence of pulmonary hypertension, only a systolic murmur may be heard, making the diagnosis more difficult and sometimes dependent upon other studies. As a rule, there is a wide systemic pulse pressure, especially after exercise. In only 14 of 62 patients studied by Shapiro (3) was this pressure normal. Other less specific features in the history and physical examination have been fully recorded elsewhere (2, 4).

CARDIAC CATHETERIZATION

Cardiac catheterization, by demonstrating a significant increase in the oxygen content of the pulmonary artery blood over that in the right ventricle, sug-

gests the diagnosis. Aortic-pulmonary septal defect, while rare, may present a similar finding. At times the examiner is fortunate enough to guide the catheter through the ductus into the descending aorta. Determinations of pressure and blood oxygen content of the left heart circulation are then obtained. Such passage is undeniable evidence of a patent ductus, but it is not accomplished in the majority of cases. In patients with reversed flow due to pulmonary hypertension, recognition by this procedure requires that the ductus be catheterized (5).

ROENTGEN FINDINGS

Several papers have analyzed comprehensively the roentgen findings in patent ductus arteriosus (6). It is to be stressed that, with the exception of special angiographic studies, the usual roentgen examination is seldom diagnostic. The characteristic findings are: slight to moderate enlargement of the pulmonary artery, left auricle, and left ventricle; an increased amplitude of pulsation in the aorta, pulmonary artery, and left ventricle; an increase in caliber of the peripheral pulmonary vessels, which may show "hilar dance." This latter observation is more frequently made in intracardiac shunts. Except in cases in which congestive heart failure is present, the heart is seldom greatly enlarged.

Two types of contrast examination are available: angiocardiology and thoracic aortography. Generally the findings by angiocardiology are disappointingly non-specific, although a few decisive features are occasionally encountered. In our experience angiocardiology is distinctly more rewarding in other forms of congenital heart disease. Our use of it in patent

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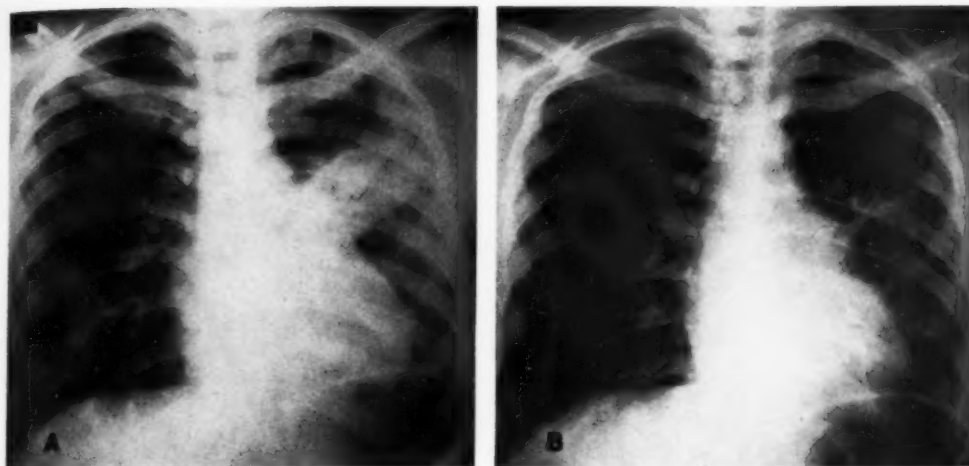


Fig. 1. Case I. Gonorrheal endarteritis with pulmonary infarction. A. Sept. 25, 1947, shortly after admission. Left ventricular enlargement and pulmonary infarction. B. Dec. 15, 1947, eight weeks after ductus ligation. The heart is smaller and the infarct has partially cleared, leaving linear scarring.

ductus is limited to "atypical ducti"—the problem cases.

Thoracic aortography is a considerably more precise roentgenographic procedure for recognition of this lesion, as shown by Jönsson, Brodén, and Karnell (7, 8). In 10 of their patients, clearly demonstrating the ductus, they were able to measure its width, and in 6 its length, with considerable accuracy as determined by subsequent surgical exploration. As aortography can be hazardous, our experience with it has been limited to a few problem cases.

In reviewing the records of 85 patients with surgically treated patent ductus arteriosus at the University of Michigan Hospital, we encountered several unusual roentgen manifestations of this lesion and certain of its complications. These are presented in detail below. This writing concerns only patients in whom a patent ductus was the sole congenital abnormality of the heart and great vessels.

Acute Bacterial Endarteritis with Pulmonary Infarction

CASE I: E. J., a 15-year-old Negro boy, gave a history of limited exercise tolerance for as long as he could remember. The onset of headaches, chest pain, and fever led to his admission to the hospital. Five months previously he had a purulent urethral

discharge, which disappeared in about a week without treatment. On admission he was acutely ill, with a temperature of 103°, pulse 130/min., respirations 35/min. Signs of consolidation were present at the left lung base. The heart was enlarged and hyperactive, with a loud continuous systolic and diastolic murmur in the left first and second intercostal spaces. Blood pressure was 135/50-0 mm. Hg.

Laboratory Data: Red blood cells, 2,800,000; hemoglobin 8.1 gm.; white cells 22,900 with 87 per cent neutrophils. Three blood cultures showed *Neisseria gonorrhoeae*.

X-ray Examination (Fig. 1): Initial films showed scattered small opacities in both lungs. In some areas these disappeared under treatment; in others they enlarged before resolving slowly, leaving linear residuals. No excavation was observed, but there was a left pleural effusion. The heart initially showed left ventricular enlargement, with pulmonary and hilar arteries that pulsated vigorously.

Course: On admission, the patient was thought to have rheumatic aortic insufficiency with subacute bacterial endocarditis. Later, when the typical ductus murmur was recognized, bacterial endarteritis of the ductus with pulmonary infarction was suspected. Large doses of sulfadiazine and penicillin brought the temperature to normal and sterilized the blood. Two months later a large patent ductus (12-14 mm. diameter) was uneventfully ligated. As shown roentgenographically, the heart decreased in size before this procedure and subsequently became normal (Fig. 1). One year later the patient was asymptomatic, though a residual soft systolic murmur could be heard.

The frequency of bacterial endarteritis

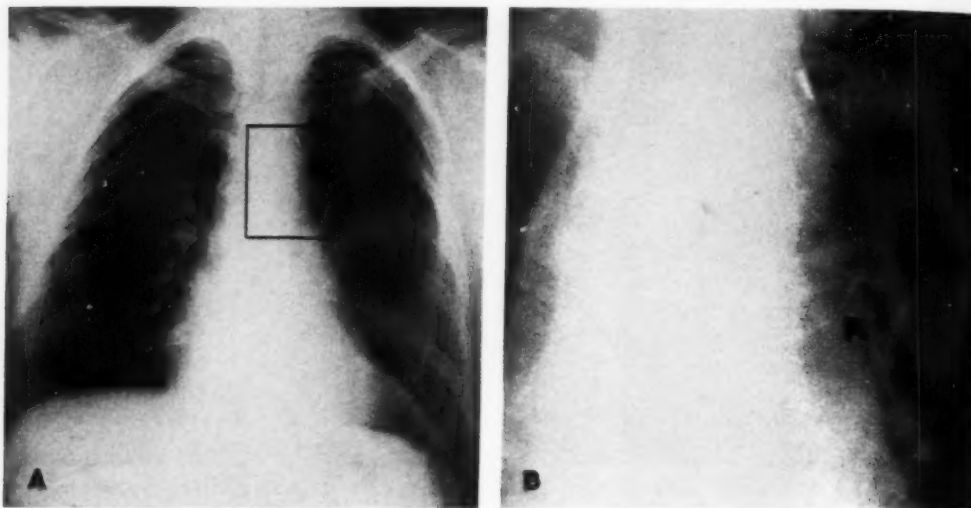


Fig. 2. Case II. A. Postoperative chest film. B. Detail of aortic calcification (arrow). The hemostatic clip above the aortic knob was not placed near the ductus.

in association with patent ductus arteriosus has been emphasized (9), but few patients now present themselves with this complication, since the typical murmur is commonly discovered on examination for some other reason. Prior to the advent of surgical treatment and antibiotics, a fatal outcome was usual; today the outlook is much more favorable. The typical location of the vegetations on the pulmonary artery side of the ductus accounts for the greater frequency of pulmonary as compared with systemic infarctions. The case reported is typical of this complication of patent ductus except for the infecting organism, *N. gonorrhoeae* rather than the more common *Streptococcus viridans*. The simple roentgen findings were not diagnostic of a patent ductus arteriosus.

Aortic Calcification at the Ductus

Calcification associated with a patent ductus was first observed radiologically by Weiss in 1931 (10). Subsequent autopsy showed that the calcific deposits actually lay in the aortic wall at the attachment of the anomalous vessel. More recently, Ruskin and Samuel (11) have presented 4 examples in young females, in

1 of whom surgical exploration was done. The calcification was in the form of a ring in the aortic wall at the end of the ductus. The occurrence of such calcification may possibly be more frequent than its roentgenologic demonstration. The opinion has been expressed that it is found more commonly as a sequel to bacterial endarteritis.

CASE II: E. B., a 29-year-old white woman, complained only of fatigue and palpitation until ten months before admission, when she experienced the onset of daily fever, malaise, migratory arthralgia, and nose bleeds. She had sustained a weight loss of 30 pounds. On admission, she was acutely ill, with a temperature of 102° F., pulse 124/min., respirations 24/min.

Abnormal physical findings were a typical ductus murmur with systolic thrill and enlargement of the liver and spleen. No petechiae were present. Blood pressure was 122/52 mm. Hg.

Laboratory Data: Red blood cells 3,200,000; hemoglobin, 9 gm.; white cells, 10,000, with 81 per cent neutrophils. Several blood cultures produced *Streptococcus viridans*.

X-ray Examination (Fig. 2): The heart appeared normal except for a curvilinear calcific deposit in the aorta. No sign of pulmonary infarction was discovered.

Course: Recovery eventually occurred after a protracted regime of sulfadiazine and penicillin, followed by surgical ligation of the patent ductus. The calcification was not identified at operation.

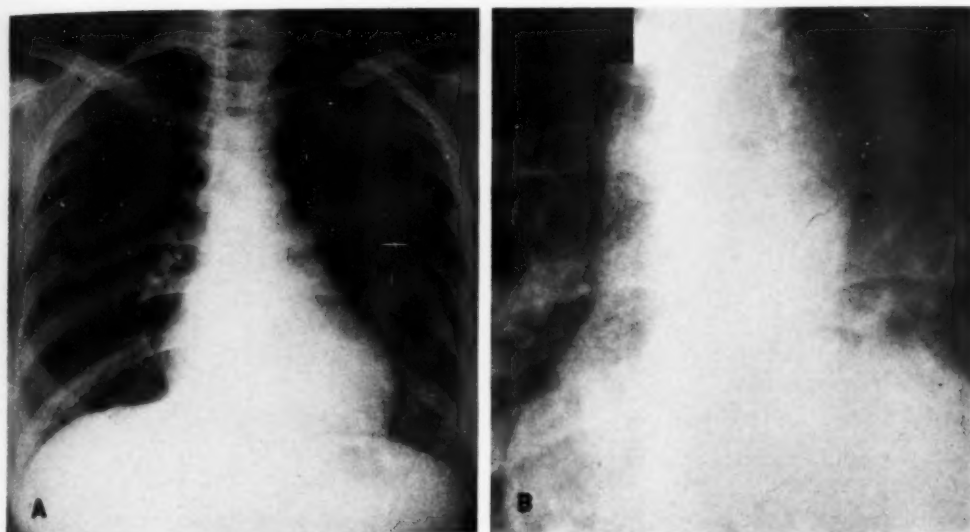


Fig. 3. Case III. A. Normal appearing chest. B. Spot film showing the usual concavity below the aortic knob replaced by a shallow bulge in the upper descending aorta (arrows).

This patient showed calcification of typical appearance in the usual location, namely, a segment of a circle larger in diameter than the aortic knob, lying, with concave side up, at a site slightly lower than the expected position of the underside of the arch. This can be mistaken for a simple atheromatous plaque in the arch. In a young person in whom a patent ductus is suspected clinically, its presence confirms the diagnosis. In reviewing 85 cases we found such calcification in 3 women, aged twenty-nine, thirty-three, and thirty-nine. We have not seen it nor is it reported to have been found in infants or children.

Aortic Enlargement Near a Patent Ductus

Rokitansky (15) recognized a funnel-shaped enlargement of the aorta at the insertion of the patent ductus, but this had little practical significance until the angiographic findings in the latter anomaly were first described by Steinberg, Grishman, and Sussman (12) in 1943. They noted the great frequency of a slight fusiform enlargement of the upper descending aorta near the ductus. Lately, Jönsson and Saltzman (13) have identified this

"infundibulum of the patent ductus" on simple films after having seen it to better advantage on thoracic aortograms.

CASE III: A 25-year-old woman was asymptomatic but had known of the presence of a heart murmur since the age of two. The typical ductus murmur, with blood pressure 100/58 mm. Hg, was found. On X-ray examination (Fig. 3), the heart appeared normal in size, shape, and activity except that the upper descending aorta seemed larger than normal. The aortic impression on the esophagus was elongated.

Course: A small patent ductus was uneventfully ligated. Unfortunately, observations of aortic size were not recorded.

Though observations are incomplete in this case, the films are shown as an example of the aortic enlargement visualized on plain roentgenography. Jönsson and Saltzman found it in 21 of 39 surgically verified examples of patent ductus, but never in normal subjects. In our review, which covers a wide age range, this sign was convincingly demonstrated in only a few instances. Having been alerted to it, our surgical colleagues have examined the aorta carefully in recent cases, but they, too, report enlargement only infrequently. While we have been unable to confirm Jönsson

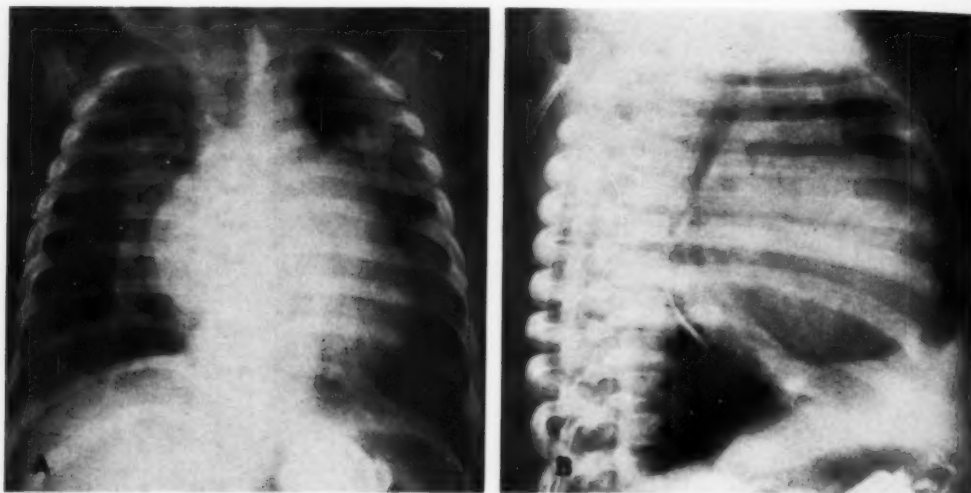


Fig. 4. Case IV. A. The heart is generally enlarged; pulmonary vessels are prominent. B. Esophageal displacement, indicating left auricular enlargement.

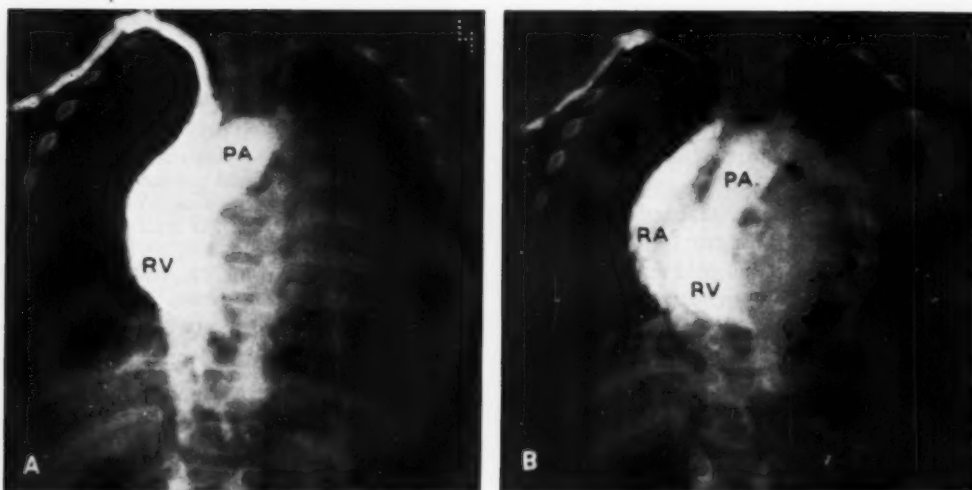


Fig. 5. Case IV. Frontal angiocardigram. A. At two seconds. Normal right heart displaced to the right by large left chambers. Initial filling of pulmonary artery. B. At 2 1/2 seconds. Sharply demarcated (though transient) filling defect in pulmonary artery (arrow), the jet defect. RA. Right auricle. RV. Right ventricle. PA. Pulmonary artery.

son's and Saltzman's findings in detail, we have observed the aorta to be generally larger in patent ductus than in other left-to-right shunts, particularly those due to auricular septal defects.

ANGIOCARDIOGRAPHY IN PATENT DUCTUS

Angiocardiography seldom demonstrates the ductus directly, as does aortography

(7, 8). The indirect signs which suggest the lesion fall, in our opinion, in the following order of specificity:

1. Reopacification of the pulmonary artery from the aorta. To be certain the right ventricle is empty, a left anterior oblique view is obtained

2. Localized slight enlargement of the upper descending aorta (12). Several pa-

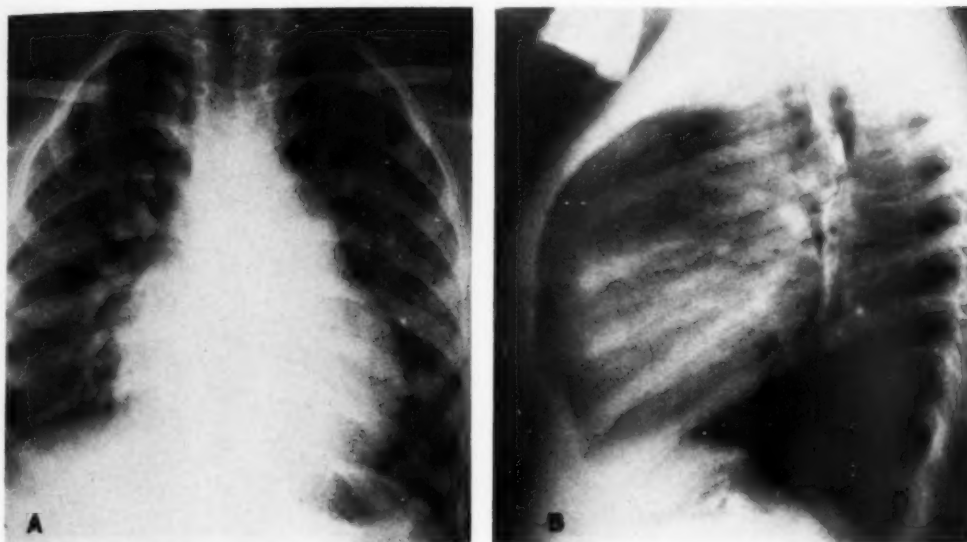


Fig. 6. Case V. A. Moderate enlargement of heart and pulmonary artery. B. Sternal protrusion suggesting right ventricular enlargement.

tients without patent ductus have been seen with similar enlargement of the aortic isthmus.

3. Enlarged left auricle and left ventricle in suspected left-to-right shunt.

4. Prolonged opacification of a large pulmonary artery and hilar arteries.

Two more specific signs recently added are:

1. A transient defect in opacification of the pulmonary artery due to a jet of non-opaque blood from the aorta.

2. Reversed flow through the ductus.

Goetz (16) first publicized the "jet sign" in 1951. It is a transient defect in the contrast column in the left pulmonary artery caused by a jet of non-opaque blood reaching this vessel from the aorta through the ductus. On the same basis, dilution of contrast medium in the left pulmonary artery was noted by Dotter and Steinberg (29).

CASE IV: E. B., a 4 1/2-month-old colored boy, was admitted after having been treated for congestive heart failure and pneumonia for the preceding month in another hospital. He was acutely ill, underdeveloped, and dyspneic. Râles and wheezes filled both lungs. The typical ductus murmur with systolic thrill and loud pulmonary second sound was

heard. The blood pressure was 110/30 mm. Hg.

Laboratory Data: Red blood cells, 5,100,000; white cells 7,600; arterial oxygen saturation, 87 per cent. The electrocardiogram showed left axis deviation in the limb leads and high voltage in the precordial leads, interpreted as evidence of enlargement of both ventricles.

X-ray Examination (Fig. 4): The left auricle, left ventricle, and pulmonary artery appeared enlarged, the latter showing prominent pulsation on screening. Patchy infiltration was present in the right lower lobe. An angiocardigram (Fig. 5) showed an inconstant defect in the opacification of the pulmonary artery (the "jet" sign) and enlargement of the left auricle and ventricle. The enlarged pulmonary arteries were again opacified from the aorta.

Course: After stabilization of the infant's condition, ligation of a patent ductus (5 mm. diameter) was successfully accomplished.

While the "jet" defect in the pulmonary artery is probably quite specific for a patent ductus, similar defects may be seen at other anomalous communications, due to incomplete mixing of opaque and non-opaque blood, *i.e.*, ventricular septal defect, anomalous insertion of pulmonary veins, etc.

Besides showing the "jet" sign, this case illustrates enlargement of the left auricle and congestive failure, two common

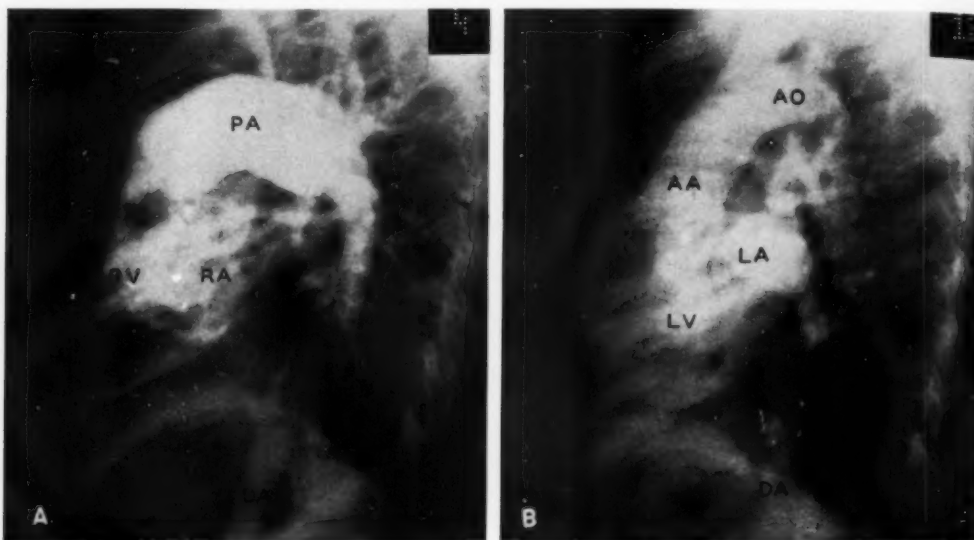


Fig. 7. Case V. Lateral angiocardigrams. A. At two seconds, showing right auricle (RA); right ventricle in systole (RV); dilated pulmonary artery (PA); premature opacification of descending aorta (DA) due to right to left shunt through the ductus. Ascending aorta not opaque. B. At six seconds. Right heart no longer opaque; left auricle (LA), left ventricle in systole (LV), ascending aorta (AA), aortic arch (AD). The descending aorta (DA) is distinctly less opaque, due to right-to-left shunt of non-opaque blood through the ductus, which itself cannot be directly identified.

manifestations of a patent ductus in infancy.

Reversed Flow through the Patent Ductus

CASE V: M. B., a 5-year-old white girl, suffered from exertional dyspnea, chest pain, and fatigability but was never noticeably cyanotic. On examination, her chest was found to have a prominent precordial bulge. A harsh systolic murmur was heard in the left third interspace. A decrescendo diastolic murmur followed the very loud pulmonary second sound. Blood pressure was 110/70 mm. Hg. Clubbing was not present. An electrocardiogram showed signs of right ventricular hypertrophy.

X-ray Examination (Fig. 6): The heart was slightly enlarged, with signs of right ventricular hypertrophy. The pulmonary arteries were enlarged and hyperpulsatile.

Cardiac Catheterization: On cardiac catheterization, pulmonary and right ventricular hypertension

was found. The catheter passed from the pulmonary artery into the descending aorta indicating the presence of a patent ductus. Slightly unsaturated blood was obtained from the descending aorta.

Angiocardiology (Fig. 7): The descending aorta opacified during the filling of the very large pulmonary artery. The ascending aorta did not fill until later, when the left ventricle became opacified. At this time the contrast medium had cleared from the right ventricle and the descending aorta was relatively less dense than the ascending aorta. These findings were interpreted as indicative of a right-to-left shunt through a patent ductus.

Course: A patent ductus (5 mm. diameter) was ligated, with resultant increase in exercise tolerance and activity. The heart decreased in size slightly. A faint systolic murmur and the loud pulmonary second sound remain. Catheterization one year later showed persistent pulmonary hypertension, 75-90/30 mm. Hg.

This case differed from the usual case of patent ductus in having clinical, radiologic, and electrocardiographic signs of right ventricular enlargement. Such signs should alert the clinician to the possibility of some other anomaly or to pulmonary hypertension complicating a patent ductus, as in this patient. While variable degrees of pulmonary hypertension occur

	Pressure (mm. Hg)	Oxygen Content Vol. (per cent)	Satura- tion (per cent)
Descending aorta.....	115/60	9.49	84.2
Undivided pulmonary artery.....	100/55	8.17	72.5
High right ventricle.....	100/0	7.21	64.0

with a patent ductus, seldom is it sufficient to reverse the flow through the ductus. Although the pressures recorded in the present case would not seem to allow such a shunt, this nevertheless existed during both right and left ventricular opacification. We have seen several other instances of reversed flow through a patent ductus, including one due to associated aortic valve stenosis and hypoplasia of the ascending aorta. Aortic coarctation or interruption proximal to a ductus might permit a similar shunt. These possibilities were eliminated at surgery in our patient, who would appear to be one of those in whom a proved reversed shunt was due only to pulmonary hypertension (5, 30, 31).

PULMONARY HYPERTENSION

The limited scope of this paper does not permit an extensive discussion of pulmonary hypertension in patent ductus arteriosus. Indications are that the condition is not as rare as originally believed and that it is probably the cause of many atypical cases of patent ductus. Clinical and laboratory evidence of right ventricular hypertrophy suggest its presence. Taussig (17) has discussed the etiology of primary pulmonary hypertension. It is perhaps neurogenic in some patients; in others it may be explained by difficulty in opening of the pulmonary vascular bed following birth. Tremendous shunts, increasing the flow in the pulmonary artery by more than three times, could theoretically produce pulmonary hypertension (18). Ekström, Ekman, and Möller (19) have produced pulmonary hypertension in a dog by making a wide artificial ductus arteriosus-like communication. The pulmonary arterial pressure increased to four times the original value in two months following the creation of the shunt. As a corollary, in a case reported by Cournand (20), pulmonary hypertension lessened after ligation of a patent ductus arteriosus. Hudson and Campbell (21, 22) have reported disappearance of the characteristic continuous murmur and appearance of a reversed shunt following the development

of pulmonary hypertension. These observations suggest that there may be several causes of pulmonary hypertension occurring in association with a patent ductus arteriosus. It may be present from birth or acquired later. Dammann, Berthrong and Bing (5) discuss this matter at length and emphasize a practical aspect, namely that ductus ligation may be detrimental, and even fatal, in the presence of long standing pulmonary hypertension with irreversible pulmonary vascular disease. In our patient, the procedure was well tolerated and distinctly beneficial, although the pulmonary pressure is relatively unchanged⁴.

Unusual Heart Shape in Infants

CASE VI: O. R., a 6-month-old girl, had a history of two attacks of pneumonia and feeding difficulties. Physically she appeared normal except for a loud typical ductus murmur and systolic thrill. The blood pressure was 90/10 mm. Hg. The electrocardiogram was within normal limits.

X-ray Examination (Fig. 8): The heart was enlarged, particularly in the region of the left ventricle. The pulmonary artery and hilar branches were not particularly prominent.

Course: At the age of twenty-three months a patent ductus was ligated, with prompt recovery. The heart had a normal roentgen appearance six months later.

An uncomplicated patent ductus presents a fairly uniform roentgen appearance, as previously described, dominated by dilatation of the pulmonary artery. Frequently in young adults the heart is of normal shape, whereas in congestive failure in infants all chambers are enlarged. We have seen several patients, like the one whose case is presented here, in whom selective left ventricular enlargement was the principal abnormality. One must not mistakenly exclude this correctable lesion because the roentgenographic appearance is atypical. This is especially true in infancy.

⁴ The variable response of pulmonary pressure to ductus ligation is considered more completely by Silver, A. W., Kirklin, J. W., Ellis, F. H., Jr., and Wood, E. H.: Regression of Pulmonary Hypertension After Closure of Patent Ductus Arteriosus. Proc. Staff Meet., Mayo Clin. 29: 293, May 29, 1954.

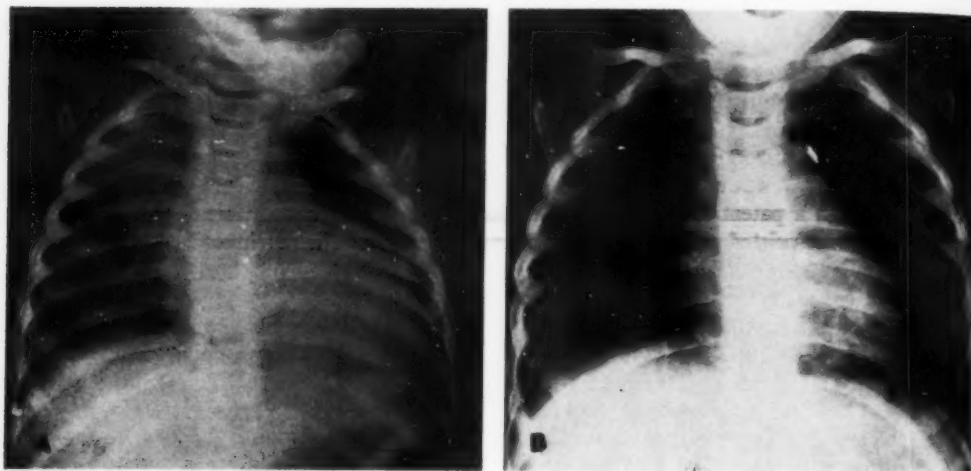


Fig. 8. Case VI. A. At age of eight months. Prominent left ventricular enlargement. The usual prominence of the pulmonary artery is lacking. B. At two and a half years, six months after ductus ligation. Striking reduction in heart size. The hemostatic clips were not placed on the ductus.

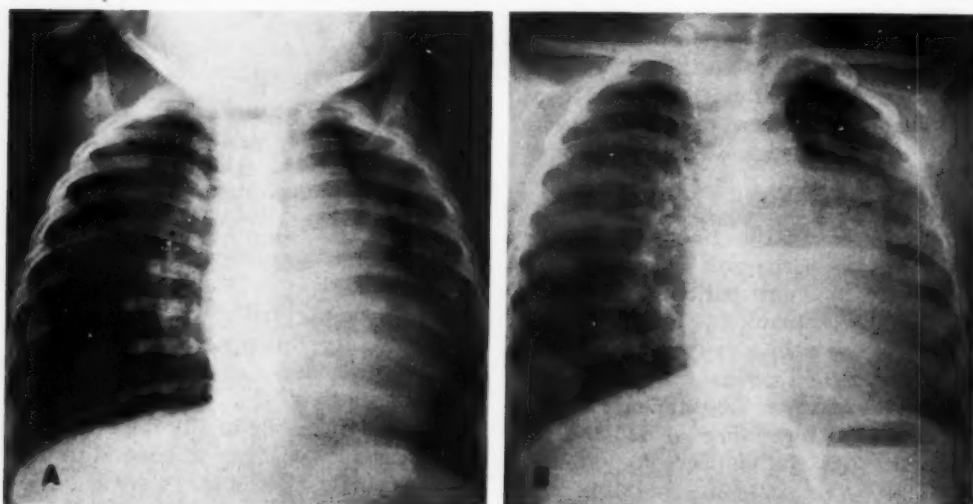


Fig. 9. Case VII. A. At eleven months. Some left ventricular enlargement; prominent pulmonary artery and right hilar branches. B. At four years. Striking increase in pulmonary artery dilatation.

Aneurysm of the Pulmonary Artery

CASE VII: R. B. suffered from dyspnea and recurrent respiratory infections. In his first year a loud basal systolic murmur was heard, and at the age of three and a half years an additional diastolic component was detected. The precordium bulged, the heart was enlarged, and the pulmonary second sound was accentuated. The blood pressure was 90/40 mm. Hg, pulse 100/min., and respirations 34/min.

X-ray Examination (Fig. 9): The heart was found

to be enlarged in the area of the left ventricle on all examinations. The pulmonary artery pulsed vigorously and became increasingly prominent, until it was considered aneurysmal.

Course: At thoracotomy, in the child's fourth year, the pulmonary artery was found to be tremendously enlarged. A patent ductus (6-8 mm. diameter) was ligated with difficulty because of interference by the large pulmonary artery. Uneventful recovery and improved exercise tolerance ensued. No check-up films are available postoperatively.

Aneurysm of the pulmonary artery is a rare entity. Deterling and Clagett (23) collected 147 proved cases from the world literature, 20 per cent of which were associated with a patent ductus arteriosus. Lindert and Correll (24) found a total of 30 cases of aneurysm of the pulmonary artery with patent ductus arteriosus. Only 4 of the patients were younger than twenty and only 1 was under ten. These authors emphasize the possibility of a pulmonary artery aneurysm developing in any patient with patent ductus arteriosus.

The case recorded here depicts the progressive increase in size of the pulmonary artery as demonstrated on routine films. It is to be noted that while on the earliest available film the pulmonary artery was only prominent, on the immediate preoperative film it appeared enormous. Whether this represented only dynamic dilatation or a true aneurysm can only be conjectured at this time, as no follow-up films or histologic studies are available. In any event, this is the largest pulmonary artery, relative to the patient's size, observed in any of our cases. It would have been of interest to determine the pulmonary pressure, but catheterization was not carried out.

In reviewing our cases of patent ductus arteriosus, we have encountered one other case with associated proved aneurysm of the pulmonary artery. That case is not included here because of the presence of other congenital vascular anomalies found at autopsy.

Aneurysm of the pulmonary artery is to be distinguished from aneurysm of the ductus arteriosus itself. The latter is very unusual, only 31 cases having been described up to 1949 (25). It is most commonly found in infants. According to Kneidel, such an aneurysm can frequently be confused with an anterior mediastinal tumor unless angiocardigraphic studies are undertaken. We have not encountered such a case.

DISCUSSION

While the signs and unusual aspects of

patent ductus arteriosus discussed are not new, they are not considered in the diagnosis of this lesion as often as we believe they should be. The frequency of the condition, its complications, and the potential irreversibility of cardiac and pulmonary changes if surgical repair is too long delayed, make discovery imperative in the light of the relative simplicity of surgical correction. Shapiro and Keys (9, 26), in a study of untreated adults with patent ductus arteriosus, estimated that their life expectancy is reduced by nearly thirty years. They showed further that subacute bacterial endocarditis accounted for 41.7 per cent of the deaths, while congestive heart failure accounted for 28.3 per cent. The advances in antibiotic therapy have somewhat changed the previous bleak outlook in subacute bacterial endocarditis, but continuous or even intermittent prophylactic chemotherapy, with all its pitfalls and inherent dangers, is certainly no substitute for complete correction of the underlying defect. Dry, Harrington, and Edwards (27) and Dammann, Berthrong, and Bing (5) have reported cases in which the persisting shunt caused permanent cardiac and pulmonary vascular changes. The effects could not be reversed and the patients died after ductus ligation.

In reviewing the results in 412 surgically treated cases, Gross and Longino (28) found that the overall mortality rate was 2.1 per cent, but that in patients without preoperative complications this figure was reduced to 0.5 per cent.

It is often the patient whose patent ductus arteriosus represents the greatest threat to life who offers the greatest diagnostic difficulties. Since there is so much to gain when the diagnosis can be made, it is extremely important for the diagnostician to be completely familiar with all the roentgenologic aspects of the condition.

SUMMARY

Diagnostic findings in patent ductus arteriosus have been briefly reviewed, with special attention to seven unusual and

instructive roentgen findings which have not received the attention they deserve. These neglected but important roentgen signs are:

1. Pulmonary infarction due to bacterial endarteritis (*N. gonorrhoeae*).
2. Calcification in the aortic origin of the ductus.
3. Dilatation of the descending aorta at the origin of the ductus—the "infundibulum of the patent ductus arteriosus."
4. Angiocardiographic "jet defect" in the pulmonary artery.
5. Reversed shunt through the ductus, due to pulmonary hypertension demonstrable by angiocardiography.
6. Unusual heart shape in infancy.
7. Aneurysm of the pulmonary artery.

The therapeutic importance of recognizing this lesion is stressed. Awareness of the unusual as well as the more common findings will enable the roentgenologist to be of greater service in this effort.

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SUMARIO

Extrañas Manifestaciones Roentgenológicas del Conducto Arterioso Permeable

Al repasar los protocolos de 85 enfermos con conducto arterioso permeable tratados quirúrgicamente en el Hospital de la Universidad de Michigan, observáronse varias extrañas manifestaciones radiológicas de esta lesión y algunas de sus complicaciones. Esos desatendidos, pero importantes, signos roentgenológicos son: (1) infarto pulmonar debido a endarteritis bacteriana (*N. gonorrhoeae*); (2) calcificación en el origen aórtico del conducto; (3) dilatación de la aorta descendente en el origen del conducto—el “infundíbulo del

conducto arterioso permeable”; (4) el “defecto en chorro” observado angiocardiográficamente en la arteria pulmonar; (5) desviación invertida a través del conducto debido a hipertensión pulmonar revelada por la angiocardiógrafa; (6) extraña forma del corazón en la infancia, (7) aneurisma de la arteria pulmonar.

Recálcase la importancia terapéutica del reconocimiento de esa lesión. La atención prestada a los hallazgos raros así como a los más comunes capacitará al radiólogo para ser de mayor utilidad en este sentido.



Non-Traumatic Pneumopericardium and Pyo-Pneumopericardium. Report of Two Cases¹

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THOUGH NON-TRAUMATIC pneumopericardium is an unusual finding on roentgen examination of the chest, the diagnostic features are specific. In a review of the Hines Hospital records, only 2 cases were found. In one of these a gastric ulcer perforated into the subdiaphragmatic space and formed a fistulous tract, with extension into the pericardium. A peptic ulcer of the myocardium and pyo-pneumopericardium developed. In the second case an esophageal carcinoma, with necrosis, extended to the pericardium, producing pneumopericardium.

ETIOLOGY

Various mechanisms have been described for the production of pneumopericardium. Regardless of the underlying cause, infection commonly occurs, so that eventually pyo-pneumopericardium is present.

Ludwig Pick (1), in 1894, published a monograph on perforation of the diaphragm by gastric ulcer as observed in 28 cases. In 10 of these, the pericardium was involved, and in 4 the myocardium was perforated. In some cases ulcerations of the posterior gastric wall had perforated into the left pleura. Most of the pericardial perforations were due to ulcers on the lesser curvature.

In 1904, James (2) reviewed 38 cases of pneumopericardium and added 1 of his own. In 16 of the cases, trauma was responsible for the entrance of air into the pericardium. Other less common causes of pneumopericardium were perforations secondary to esophageal ulcer (3 cases), pulmonary tuberculosis (3 cases), esophageal carcinoma (2 cases), and gastric ulcer (2 cases). In single instances, pericardial perforation was attributable, respectively, to liver abscess, pneumothorax, lung abscess, communication with a bronchus in

suppurative pericarditis, and direct pericardial paracentesis. Single cases were also included of pneumopericardium (or pyo-pneumopericardium) due to pericarditis without demonstrable connection with any outside air-containing structure, presumably caused by a gas-forming organism, and of ulceration of a necrotic hilar lymph node, possibly by the same mechanism, although this is not accurately described. James' case was one of esophageal perforation by a swallowed piece of bone.

Tylecote (3) reported a case of gastric ulcer perforating into the heart. The patient was found dead, and autopsy showed an ulcer on the posterior part of the left ventricle communicating with the stomach. Monroe (4) cited 2 cases (reported by others) of rupture of the heart by gastric ulcer; Johannessen (5) and Rappert (6) each described a single similar case.

Perforation of an amebic abscess of the left lobe of the liver into the pericardium was reported by Hartz (7). Outerbridge (8) published a case of pyogenic abscess of the left lobe of the liver perforating into the pericardium.

In Gottesman's (9) case, pneumopericardium was secondary to radiation necrosis. A carcinoma of the fundus of the stomach was treated by the implantation of radium needles and pneumopericardium occurred two months later. A gastrointestinal series showed barium in the pericardium. The patient died four days after the appearance of pneumopericardium, and postmortem examination showed pericardial perforation and a fistulous tract leading from the stomach. A second case of pneumopericardium complicating carcinoma of the stomach was reported by Harp and Peeke (22).

Inflammation in the lungs or pleura with

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perforation into the pericardium was reported by Brink (10), Lages Netto (11), and Cooperstock (12). In these cases communication was by a bronchopleural fistula or by rupture of a pulmonary abscess into the pericardium.

Rupture of the pericardium and pleura resulting in pneumopericardium in association with pulmonary tuberculosis was described by Brailsford (13). A case of spontaneous hydro-pneumopericardium occurring several years after collapse therapy for pulmonary tuberculosis was also reported by Trimble (14). In this latter case the mechanism was obscure, but necrosis of a tubercle adjacent to the pericardium was suggested.

Pneumopericardium induced accidentally during an attempt at pneumothorax has been observed. Rigler (15) reported a case of tuberculous pericarditis with effusion in which this occurred.

Pneumopericardium caused by trauma has been reported by Maguire (16), Hawkes (17), Kern (18), and Meyer (19). Trauma may be external and is usually due to a penetrating foreign body. Rarely, trauma is internal, as in esophageal perforation from swallowed foreign bodies (20). Rib fractures from external trauma may tear the pericardium.

Spontaneous pneumopericardium with recovery was described by Gilbert (21). In this case the etiology was undetermined.

This condition has been demonstrated at all ages. The youngest patients were infants of one and a half and eight months. In both of these cases pyo-pneumopericardium was secondary to perforation by a pulmonary abscess. Traumatic perforations are more common in young and middle-aged adults. Perforations secondary to malignant tumors are more often encountered in older patients.

Fluid is frequently present in addition to air, so that there is a hydro-pneumopericardium or pyo-pneumopericardium. A horizontal fluid level, when present, is clearly demonstrated. There may be concurrent mediastinitis, either primary or secondary to pericardial involvement.

Pleurisy or pneumonia is frequently an associated finding.

CLINICAL FEATURES

When pneumopericardium is due to perforation, there may be sudden onset of precordial or upper abdominal pain, dyspnea, cyanosis, and fainting.

The physical findings as a result of air in the pericardial sac are spectacular, and, in spite of the unusual occurrence of the condition, the diagnosis has been made by physical examination alone. The mixture of air and fluid produces high-pitched metallic splashing sounds with every heart beat. These sounds may be of sufficient intensity to be audible at a distance of several feet. The patient is often aware of a gurgling sensation in the chest, which is synchronous with the heart beat.

The pulse rate is increased and the temperature elevated. There is no area of absolute cardiac dullness; instead, there is a poorly defined area of hyperresonance. The percussion note is deep and tympanitic and may shift with changes in position of the patient.

The *electrocardiographic* changes are those of pericarditis. They consist of characteristic changes in the T-waves and the RS-T segment. Serial tracings are valuable, as the findings on a single tracing may not be specific for pericarditis.

ROENTGENOLOGIC ASPECTS

The parietal pericardium is visible as a relatively thin, bulging, curvilinear band of increased density separated from the heart by a radiolucent area of varying width, depending upon the amount of air present. The thickness of the parietal pericardium is dependent upon the associated inflammation and edema. The pericardial cavity is dilated more to the left than to the right. The pneumopericardium is limited above by the lower border of the aortic arch. Inferiorly, it may extend to the diaphragm if sufficient air is present and there is little or no fluid. In the presence of fluid, there is a straight line which remains horizontal in any body position. The heart pulsation

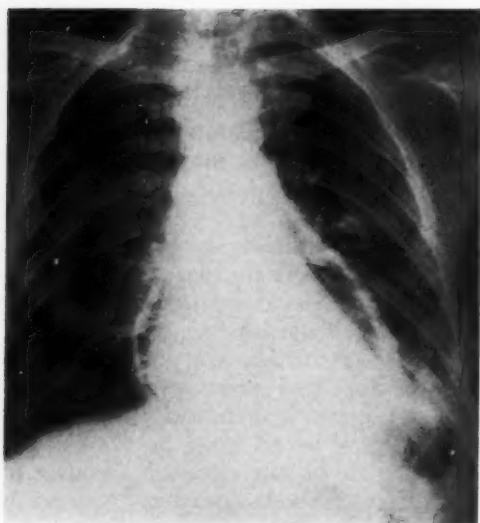


Fig. 1. Case I. Pneumopericardium. Air distends the pericardial cavity and separates the visceral and parietal pericardium.

is unusually vigorous in amplitude as observed fluoroscopically, and if fluid is present, the surface appears to quiver, be-

cause of the waves produced by cardiac motion.

On fluoroscopy, the roentgenologist may also observe a characteristic physical finding which he can occasionally call to the attention of the clinician. When the ear is placed directly to the patient's chest (a stethoscope usually not being available in the x-ray department), a loud crunching or splashing sound is heard, synchronous with the heart beat. This was noted by one of us (I. E. K.) in Case I, reported below.

CASE REPORTS

CASE I: E. T., a 47-year-old white male who had been operated on three times (including subtotal gastric resection and vagotomy) for peptic ulcer, with two subsequent hospital admissions because of gastric hemorrhage, was re-admitted to Hines Hospital on Aug. 30, 1951. While resting, five hours before, he had experienced gradually increasing precordial pain. The pain was aggravated by moving, and especially by deep breathing. Three tarry stools had been passed just prior to admission.

On physical examination, the patient appeared acutely ill and very apprehensive. The temperature was 101.6°, pulse 90, and blood pressure 104/64.

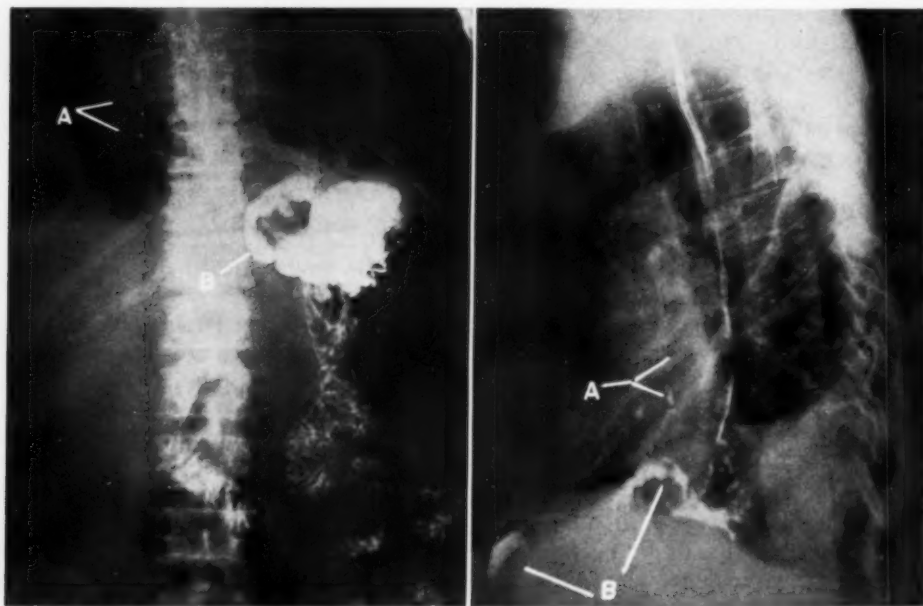


Fig. 2. Case I. Two small linear collections of contrast material in the pericardial cavity (A); sickle-shaped collection of barium (B) in the subphrenic abscess adjacent to the partially resected stomach.

Fig. 3. Case I. Lateral view showing opaque medium in the pericardial cavity (A) and medium outlining a subphrenic abscess and fistulous tract (B). The esophagus is outlined with barium and lies posteriorly.

The heart tones were clear but distant, and the rhythm was regular. The physical findings were otherwise not remarkable.

Red blood cells numbered 2,400,000, hemoglobin 7.5 gm., white cells 13,400. Urinalysis, blood non-protein-nitrogen determinations, and serology were normal. Gastric analysis showed 20 units of free acid and 44 units of total acid. The electrocardiogram (Aug. 31) was interpreted as probably normal.

A routine roentgenogram of the chest, obtained on Sept. 6, showed pneumopericardium (Fig. 1). Fluoroscopy on this date showed a definitely increased amplitude of the cardiac pulsations. At this examination the roentgenologist was the first to note, even without a stethoscope, the characteristic precordial sounds referred to above. Barium sulfate, and later Lipiodol, were given by mouth. Both media collected in a sickle-shaped pattern just below the diaphragm, apparently in a subphrenic abscess. A small amount of opaque material entered the pericardial cavity (Fig. 2). In a lateral view the abscess was seen to lie anteriorly and a fistulous tract was partially outlined (Fig. 3). The mechanism of production of pneumopericardium from the perforated gastric ulcer is illustrated in Figure 4. The course of the fistulous tract is indicated by the dotted arrow.

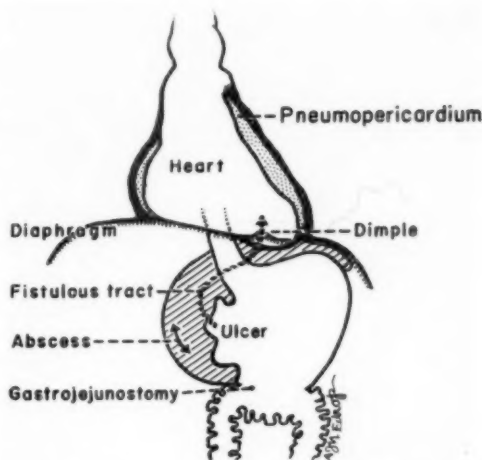


Fig. 4. Case I. Drawing showing the mechanism of production of pneumopericardium secondary to a perforated gastric ulcer.

There was venous distention, and the liver was palpable and tender. Cardiac tones were distant, and splashing sounds synchronous with the heart beat were noted clinically. An electrocardiogram



Fig. 5. Case I. Low-power view of heart, showing peptic ulcer. Below, on the left, is thickened pericardium, and above it is an edge of the ulcer. An inflammatory base and heart muscle are seen on the right

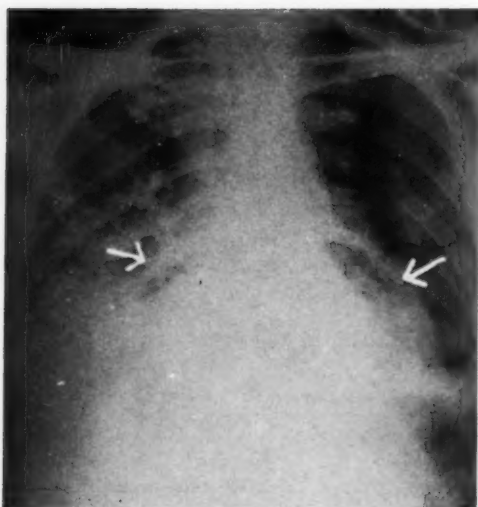


Fig. 6. Case II. Bedside roentgenogram showing pneumopericardium. Arrows point to the parietal pericardium. There is bilateral bronchopneumonia.

(Sept. 7) was abnormal, suggesting pericarditis. The heart rate was 100.

With the appearance of pneumopericardium, gastric suction was instituted, and the patient was maintained on intravenous fluids and antibiotic therapy. He was afebrile on Sept. 13.

On Oct. 6, a total gastrectomy, esophago-jejunostomy, and splenectomy were performed. During surgery, a perforated ulcer, over 7 cm. in diameter, was seen on the lesser curvature of the stomach. The edges were separated from each other and adherent to the diaphragm, leaving a large cavity containing old blood. There was a dimple on the inferior surface of the left leaf of the diaphragm anteriorly which was thought to be the site of perforation into the pericardial cavity. A needle puncture of the pericardium was made during surgery, but nothing was withdrawn. The pericardium was not explored further.

The patient was afebrile on the second postoperative day, and feeding of skimmed milk was started. On Oct. 10, 1951, he experienced sudden pain in the right chest below the heart, followed by progressively increasing dyspnea, cyanosis, and cardiovascular collapse. There was increased resonance in the left chest, and the breath sounds were absent. Thoracentesis was done, and 700 c.c. of air, viscid, turbid liquid, and food particles were removed. Death ensued on Oct. 12.

Postmortem examination revealed an abscess measuring 7×10 cm., surrounding the esophageal hiatus. Within the abscess cavity, the distal end of the esophagus and proximal jejunum at the site of anastomosis were identified. The anastomosis was separated. The left lung was collapsed, and the left

thoracic cavity contained 400 c.c. of yellow fluid. The parietal pericardium and diaphragm were adherent to the heart. In this tissue was a 4×5 -cm. ulcer with a sclerotic blood vessel in the center (Fig. 5). The epicardium was covered with purulent exudate. About 100 c.c. of purulent fluid was present in the pericardial sac. The intestines were covered with exudate and matted together. Sections of the heart through the pericardial ulceration, on microscopic examination, showed extremely thick margins composed of diaphragm, parietal pericardium, and visceral pericardium. There was considerable fibrosis in the underlying myocardium and there were fresh areas of myocardial necrosis (Fig. 5).

Anatomical diagnoses: Rupture at the site of anastomosis of esophago-jejunostomy, mediastinitis, gastro-pericardial fistula, pericarditis, myocardial necrosis, and generalized peritonitis.

CASE II: B. F., a 54-year-old white male, had experienced difficulty in swallowing since March 1947, and had undergone an exploratory operation on June 21, 1947, for carcinoma of the esophagus. The lesion was deemed inoperable, as there was infiltration of the pulmonary veins. Biopsy showed squamous-cell carcinoma.

A biopsy taken from the floor of the mouth on the left side, Sept. 23, 1947, also showed squamous-cell carcinoma. This was considered to be another primary carcinoma.

A course of x-ray therapy directed to the esophageal carcinoma was given from Sept. 26 to Oct. 25, 1947: 1,350 r (air) to each of two ports (right and left anterior oblique), 1,800 r (air) to a right posterior port, and 1,350 r (air) to a left posterior port. The factors were: 200 kv.p., 2 mm. Cu filtration, and 50 cm. distance. The patient also received from Oct. 31 to Nov. 11, 2,400 r (air) to the lesion in the floor of the mouth through an intra-oral cone. The factors were 200 kv.p., 0.5 mm. Cu filtration, and 36 cm. distance.

On Nov. 13, 1947, the patient complained of pain in the chest between the shoulder blades. Thick mucoid secretions were expectorated. The following morning he was dyspneic and expectorated foul material. Examination of the chest revealed coarse râles throughout both lungs. A bedside roentgenogram of the chest showed evidence of pneumopericardium and bilateral bronchopneumonia (Fig. 6). Death occurred on the same day. Permission for a postmortem examination was not obtained.

The final diagnosis was pneumopericardium secondary to carcinoma of the esophagus. Squamous-cell carcinoma of the mouth, and bronchopneumonia were also present.

DISCUSSION

Spontaneous pneumopericardium may be listed as one of the rare complications of peptic ulcer. In such cases a subdiaphrag-

matic abscess is formed, subsequently perforating the diaphragm and pericardium. Perforations into the pericardium are likely to be anterior and may extend into the wall of the left ventricle.

In the first case described above, the peptic ulcer responded poorly to medical management and multiple surgical procedures. Eventually, the serosa was penetrated and a subdiaphragmatic abscess was produced. This perforated the diaphragm and pericardium and resulted in pyo-pneumopericardium. There was a peptic ulcer of the diaphragmatic surface of the heart.

The second case was one of pneumopericardium due to perforation of esophageal carcinoma. In this case, it is possible that tumor necrosis resulting from radiation therapy was a factor in producing the esophagopericardial fistula.

CONCLUSION

Two cases of pneumopericardium are reported, one due to perforation of a gastric ulcer and the other to perforation of a carcinoma of the esophagus.

The literature is reviewed and the clinical and roentgenological findings are described.

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SUMARIO

Neumopericardio No Traumático y Pioneumopericardio

Preséntanse 2 casos de neumopericardio no traumático: uno debido a perforación de una úlcera gástrica y uno secundario a carcinoma esofágico. En el primer caso, la úlcera penetró en la serosa, produciendo un absceso subdiafragmático. Este a su vez perforó el diafragma y el pericardio, dando por resultado un pioneumopericardio. La

autopsia reveló una úlcera péptica de la cara diafragmática del corazón. En el segundo caso, la necrosis del tumor producida por la radioterapia tal vez fuera un factor, conduciendo a fistula esofagopericardiaca.

Repásase la literatura, describiéndose las características clínicas y radiológicas de la neumopericarditis y la pioneumopericar-

ditis. El hallazgo físico sobresaliente es un ruido metálico agudo de bazuqueo que sincroniza con el latido cardíaco y que frecuentemente puede oír el roentgenoscopista sin la ayuda de un estetoscopio. Radio-

gráficamente, se visualiza el pericardio parietal en forma de una franja curvilínea relativamente delgada y de mayor espesor que abulta y está separada del corazón por una zona de radiolucencia.



Treatment of Rare Lesions of the Uterus and Vagina¹

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LAST YEAR, while treating patients with cervical cancer, we were surprised to find a primary lymphosarcoma of the cervix. The patient received radium therapy as given for the more usual types of cancer, and the lesion has responded satisfactorily to date. This aroused our interest in the rare types of malignant disease of the female pelvic organs, for, although they are so seldom encountered, a radiologist may find himself called upon to treat such conditions at any time. Lack of experience with malignant lesions other than squamous-cell carcinoma, adenocarcinoma, or mixtures of the two, makes correct treatment a problem. One wonders how often these rare tumors occur and whether they respond to treatment which has been found effective for the more usual types of cancer.

The rare pelvic cancers treated at the Mayo Clinic during the decade 1935-44 were selected for study. Excised tissue was resectioned, stained, and restudied in all cases.

The complaints which brought these patients with unusual pelvic tumors to their physicians differed in no particular from the signs and symptoms of the more usual types of cancer; vaginal bleeding and discharge were the main complaints in nearly all instances. In many of the lesions of the corpus the bleeding was postmenopausal.

Radium and roentgen therapy played a minor role in treatment. Nearly all of the tumors under study, with the exception of the hemangioendotheliomas, are known to be resistant to irradiation (1, 2). For

malignant lesions of the cervix an intensive broken-dose method is employed, irradiating the entire cervical canal, vaginal cavity, and endometrium, with about eight applications of radium over a period of three or four weeks. This was supplemented by roentgen therapy to four pelvic ports, at 200 kv., giving 540 r (measured in air) to each port in four days, during the ten-year period under consideration. The roentgen therapy was generally repeated in three months.

Treatment of primary vaginal cancers is highly individualized, owing to the variations in extent of the cancer. Superficial areas are treated with plaques of radium containing two or three tubes of 50 mg. each in parallel arrangement, the walls of the plaques consisting of 1.0 mm. of plastic. The dose is of the order of 80 mg. hr. per square centimeter of surface covered, which delivers a surface dose of 11,500 gamma roentgens, and a dose at a depth of 1 cm. of 1,800 gamma roentgens. When a greater depth dose is desired, additional radium, in cylinders of 1.1 cm. wall thickness, is employed against the malignant tissue for 700 mg. hr. per area, delivering a dose of 1,100 gamma roentgens at a depth of 1 cm. (3).

Lesions of the corpus were usually treated postoperatively, in the hope of sterilizing any remaining malignant cells. Vaginal cylinders containing radium were mainly employed, plus roentgen therapy around the pelvis.

As regards surgical treatment following the diagnosis of these rare lesions, complete abdominal hysterectomy and bilateral

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² The Mayo Foundation is a part of the Graduate School of the University of Minnesota.

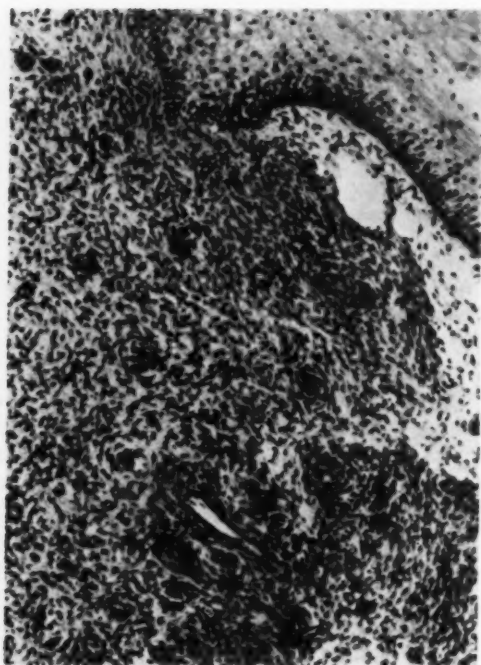


Fig. 1. Grade 1 hemangioendothelioma of the cervix. This angiomatous neoplasm is composed of endothelial-like cells which are forming small spaces containing erythrocytes. In some instances solid masses and cords of the cells are exhibited, some of which contain mitotic figures. Hematoxylin and eosin. $\times 100$.

salpingo-oophorectomy were performed whenever possible. In 3 instances only, vaginal hysterectomy and irradiation were employed instead of the more radical procedure, and in 1 case an exploratory operation revealed metastases in the liver and peritoneum, so that only palliative roentgen therapy seemed indicated.

RARE TUMORS OF THE CERVIX UTERI

During the decade under study, only 2 rare lesions of the cervix were encountered, both hemangioendotheliomas.

In 1941, a patient aged 62 years underwent dilatation and curettage for postmenopausal bleeding of three weeks duration. Since the curet was felt to penetrate the uterine wall during the procedure, total abdominal hysterectomy and salpingo-oophorectomy were performed. Examination of the excised tissue showed a Grade 1 hemangioendothelioma 5 mm. in diameter on the face of the cervix (Fig. 1). No irradiation was given. This patient has returned to the clinic at intervals, and at the

time of writing, twelve years after operation, has had no recurrence.

In 1944, a patient aged 39 years came to the clinic with a history of two months vaginal spotting terminating in flooding that required a transfusion. Pelvic examination disclosed what was apparently



Fig. 2. Sarcoma botryoides (mixed mesodermal tumor) of the vagina. Biopsies of red, soft, arborescent masses filling the vagina revealed a myxomatous vascular tumor which contained long spindle cells. The cytoplasm of the cells was coarsely granular, suggesting their origin from myoblasts. Cross striations were not found in the biopsy material. Hematoxylin and eosin. $\times 60$.

a Stage III cancer of the cervix. Biopsy showed a Grade 2 hemangioendothelioma of the cervix and vaginal wall (4). A complete course of radium therapy, irradiating the cervical canal, corpus, and vaginal walls, along with supplementary roentgen therapy, was carried out in February and March 1944. Return visits showed local arrest of the growth. Further courses of roentgen therapy were given in September 1944 and December 1945. In December 1945, roentgenograms of the chest showed a pulmonary metastasis, which gradually increased, leading to death in December 1946, approximately two and a half years after the initial treatment.

Hemangioendothelioma is a radiosensitive tumor classed by Desjardins (1) at the bottom of the list of radiosensitive malignancies.

nant tumors. Primary involvement of the uterine cervix by this tumor is extremely rare (4-6).

During the decade in which the 2 cases presented here were seen, approximately 1,273 patients were accepted for treatment



Fig. 3. Malignant melanoma of the vagina. This reveals densely packed large anaplastic cells containing large nuclei and pathologic mitotic figures. Melanin is seen within the cells and as larger extracellular masses. Hematoxylin and eosin. $\times 60$.

of cancer of the cervix, by irradiation, surgical intervention, or both. These patients had the usual squamous-cell epitheliomas, adenocarcinomas, and adenoacanthomas of the cervix.

RARE MALIGNANT TUMORS OF THE VAGINA

During the ten-year period 1935-44, approximately 116 patients with primary cancer of the vagina were accepted for treatment. Of this number, 5 showed unusual lesions.

An infant aged 2 years had a huge growth in the vaginal wall, shown microscopically to be a sarcoma botryoides (Fig. 2). Limited palliative radium treatment, given in September 1939, produced re-

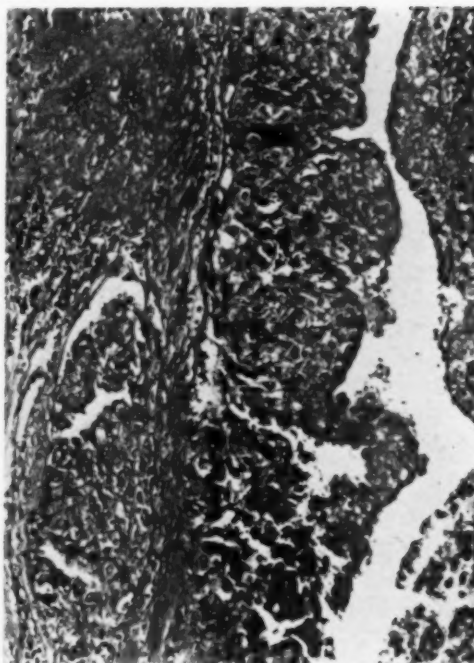


Fig. 4. Chorio-epithelioma. Masses of anaplastic trophoblasts are seen invading the myometrium. A complete search of the necrotic hemorrhagic tumor nodules failed to reveal the presence of villi. Hematoxylin and eosin. $\times 100$.

gression of the growth at first, but a rapid exacerbation caused the death of the child in December 1939, three months after treatment.

Two patients were found to have melanoeitheliomas of the vaginal wall.

The first melanoeithelioma (Fig. 3), in a patient aged 42 years, measured $3 \times 2 \times 2$ cm. This was excised in January 1941, with limited postoperative application of radium in a small vaginal cylinder against the scar. Roentgen therapy was given in November and December 1941, when metastasis was noted in the head and neck of the right femur. Death followed in the summer of 1942.

The second patient was found to have a malignant spindle-cell melanoma. A year after vaginal and external radium therapy, local excision of tumor tissue extending to the vulva and buttocks was carried out. The patient died Nov. 17, 1941, eleven months after operation; the initial response to treatment had been encouraging.

Melanoeithelioma is one of the tumors most resistant to irradiation. Surgical treatment, when possible, offers the only hope (7).

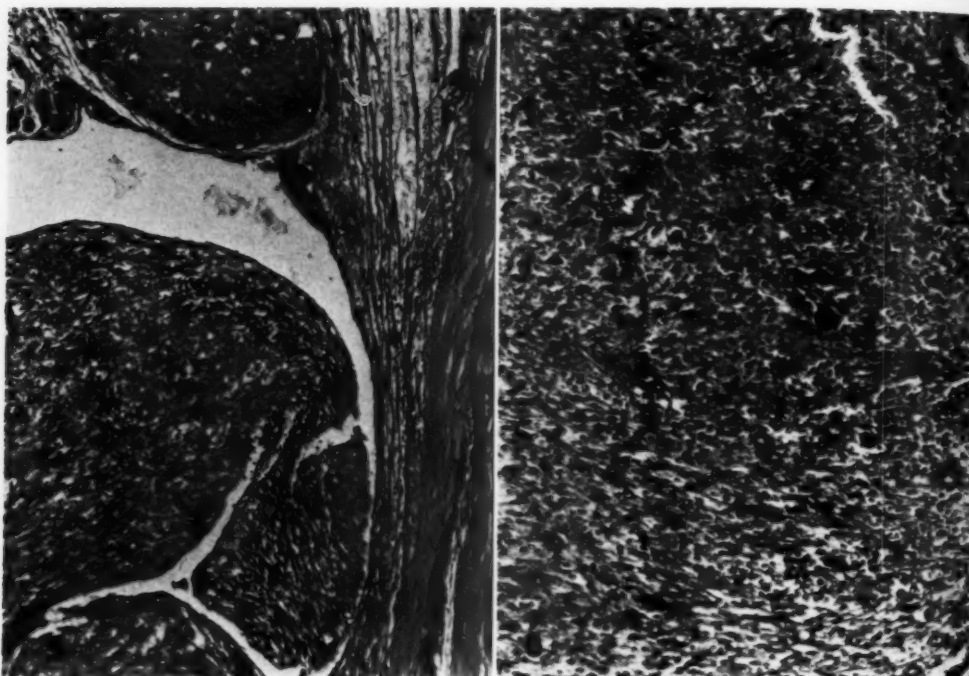


Fig. 5. Grade 4 leiomyosarcoma which arose in a myoma. This section reveals a mass of tumor tissue which has invaded a large vascular space. Hematoxylin and eosin. $\times 80$.

Fig. 6. Grade 4 leiomyosarcoma of the myometrium. This tumor is composed of spindle cells which in less anaplastic areas resemble smooth muscle cells. In this area of the tumor, giant cells and mitotic figures are common. Hematoxylin and eosin. $\times 100$.

The remaining patients had Grade 3 leiomyosarcomas of the vaginal wall.

The first of these patients was the only one with a vaginal tumor treated solely with irradiation. Clinically she appeared to have a Stage IV carcinoma of the pelvis. Initial biopsy of the vaginal wall showed a Grade 3 leiomyosarcoma. The patient received limited radium therapy with the use of intravaginal cylinders in 1940, 1941, and 1942, with roentgen therapy at each visit in addition. She obtained good palliation over a three-year period, but died in January 1944, three years and two months after her initial treatment.

The other patient with a Grade 3 leiomyosarcoma came to the clinic following vaginal and rectal applications of radium given elsewhere three months previously, along with roentgen therapy. On Sept. 7, 1937, eight tumors of the vaginal wall were excised. Death from malignant disease occurred Feb. 12, 1940.

RARE TUMORS OF THE CORPUS UTERI

Of 789 cancers of the corpus uteri accepted for treatment in the ten-year period,

20 proved to be other than the usual adenocarcinoma or adeno-acanthoma. The ages of the 20 patients ranged from twenty-nine to seventy-one years, the average being 51.3 years.

One tumor, in a woman of 29 years, was a Grade 4 chorio-epithelioma of the uterus (Fig. 4) (8, 9). On June 15, 1943, total abdominal hysterectomy and bilateral salpingo-oophorectomy were performed, with postoperative radium therapy by radium plaques and telecurietherapy to metastatic growths in the vaginal wall and vulva. The patient died four months later.

Of the remaining 19 cases, 17 were diagnosed as leiomyosarcoma of the corpus uteri, 5 of them being of Grade 1, 2 of Grade 2, 8 of Grade 3, and 2 of Grade 4, *i.e.*, 7 low-grade and 10 high-grade, microscopically (Figs. 5 and 6). The others comprised 1 mixed mesodermal tumor with cross striations (Fig. 7) and 1 carcinosarcoma (Fig. 8).

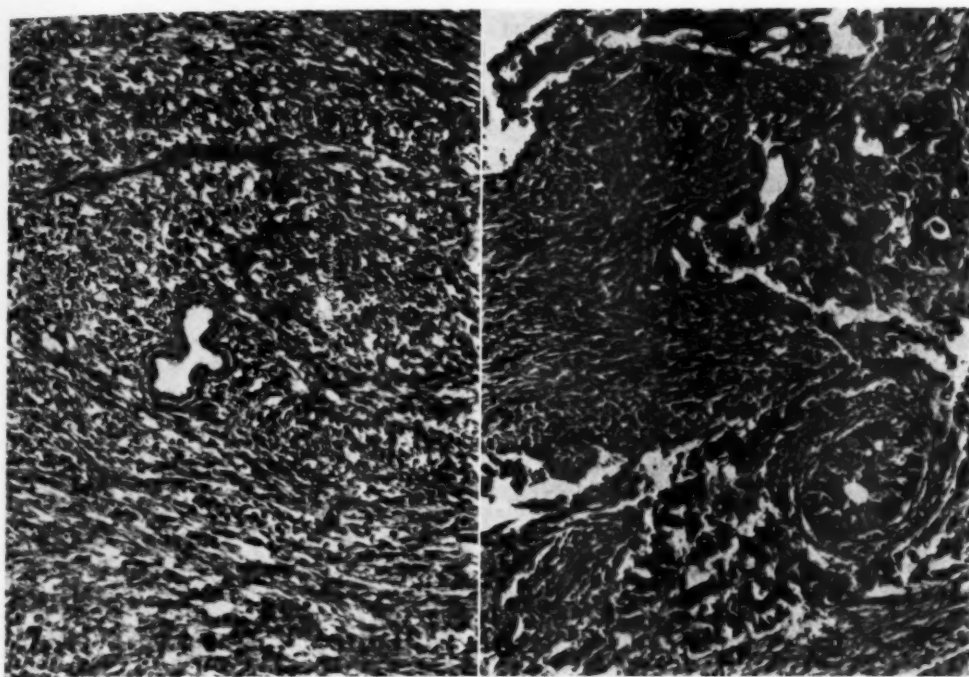


Fig. 7. Mixed mesodermal tumor of the endometrium. This section reveals a spindle-cell tumor growing around a benign endometrial gland. Many of the spindle cells exhibited cross striations in their strap-like cytoplasm. Hematoxylin and eosin. $\times 100$.

Fig. 8. Carcinosarcoma of the endometrium. This section reveals a mixture of a highly anaplastic adenocarcinoma, which is attempting to form glands, and a malignant spindle-cell element which resembles a fibrosarcoma. Hematoxylin and eosin. $\times 100$.

Since fibrosarcomas and myxosarcomas have been classified among the radio-resistant growths, one would expect the attack on these lesions to be mainly surgical. Leiomyosarcomas are closely related to fibrosarcomas and myxosarcomas and appear to be equally radioresistant. In only 2 cases was irradiation alone employed. In 18 patients, surgical treatment was used, usually total abdominal hysterectomy and bilateral salpingo-oophorectomy. Eight patients received surgical treatment plus irradiation, but the irradiation was necessarily limited in scope. With the uterus and accessory organs removed, postoperative roentgen therapy to the pelvis was given in most cases, occasionally supplemented by cylinders containing radium for general vaginal irradiation or plaques containing radium applied to specific lesions of the vaginal wall.

Thirteen of the 20 patients died within the first five-year period, and 1 died more than five years after treatment. Six were living and well at last examination, from eight to thirteen years after therapy. The patient who died after five years was treated surgically, with subsequent radium and roentgen treatment for a recurrent lesion of the same type.

Of the 6 living patients, in all of whom the lesion has been arrested for eight years or more, 1 had a leiomyosarcoma Grade 4, 1 a leiomyosarcoma Grade 3, and 4 leiomyosarcoma Grade 1. All 6 underwent radical surgical treatment, 2 having postoperative roentgen therapy also.

Of 2 patients treated with irradiation alone, 1 received only palliative roentgen therapy for a leiomyosarcoma, Grade 3, since an exploratory operation had shown metastasis to the liver and peritoneum;

she lived only three months. The second patient had three courses of roentgen therapy for a Grade 2 leiomyosarcoma following myomectomy elsewhere. She succumbed after two years.

DISCUSSION

The incidence of these rare malignant lesions seen at the Mayo Clinic can be given only approximately, and is based only upon patients *treated* at the clinic. No record has been kept of the patients with pelvic cancer diagnosed at the clinic but not treated because they preferred treatment nearer home or had just received treatment elsewhere, or for other reasons.

The cervix uteri showed the lowest incidence of unusual malignant growths: 2 cases among 1,273 patients treated, or about 1 to every 636 patients with the more usual types of cancer.

Primary vaginal cancer offers difficulties in evaluation, since in advanced lesions the primary site is doubtful. Of 116 cases termed "primary vaginal cancer" accepted for treatment, 5 were rare forms or 1 in every 23 cases.

Unusual malignant growths of the corpus uteri bore the proportion of 1 to every 39 patients with the usual malignant uterine disease. In many of these, uterine fibromyomas had undergone malignant change.

In the cases studied, irradiation has played a minor therapeutic role, with the exception of the exceedingly rare hemangioendothelioma of the cervix. This lesion is known to be radiosensitive and should respond to radium and roentgen therapy. The patient now living and well twelve years following surgical treatment had a very small lesion. The second patient, with extensive hemangioendothelioma and in poor general condition, did well for two and a half years, but succumbed to a distant metastatic growth.

The rare tumors of the vaginal wall presented the poorest prognosis of all. None of the 5 patients did well with either sur-

gical or irradiation therapy. This is in accord with the poor prognosis of the usual high-grade, rapidly growing squamous-cell epithelioma originating in the vaginal wall.

Of the 20 unusual malignant growths of the corpus uteri, 7 showed good results of treatment. Six patients are now living and apparently well, eight to thirteen years after treatment. Four of these had surgical treatment only; 2 had surgical treatment plus postoperative roentgen therapy. Two had high-grade lesions on microscopic examination and 4 had low-grade lesions.

One patient who died had a satisfactory result. She received radium therapy in 1935 for a Grade 4 myosarcoma recurrent in the vagina following total abdominal hysterectomy and bilateral salpingo-oophorectomy at the clinic a year previously. She lived for five and a half years following treatment.

In conclusion, we found that of 2,178 patients with pelvic cancer treated during the decade under study, 27 presented unusual pelvic tumors. In 8 of these, good results may be said to have been obtained. Seven of these 8 patients are still living and apparently well—all treated surgically, 2 with postoperative roentgen therapy. Except for the very rare hemangioendothelioma of the cervix, all the lesions were of types known as resistant to irradiation therapy. One patient with Grade 4 myosarcoma had a good result with radium therapy, having been treated for recurrence following radical surgical treatment. In general, therefore, while the main attack on these tumors has been surgical and should continue so, we feel that, if operation in any individual presents much risk, irradiation may at least afford worth-while palliation even in some radioresistant neoplasms.

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SUMARIO

Tratamiento de las Lesiones Raras del Utero y de la Vagina

Entre 2,178 casos de cáncer pelviano tratados en la Clínica Mayo en el decenio 1935-44, 27 eran de forma extraña.

El cuello uterino reveló la incidencia mínima de tumores malignos extraños: 2 casos entre 1,273 enfermas tratadas, o sea 1 por cada 636 enfermas que padecían de las formas más habituales de cáncer. Ambas de esas lesiones raras eran hemangioendoteliomas.

El cáncer vaginal primario plantea problemas en su justipreciación, dado que en las lesiones avanzadas, es dudoso el asiento primario. De 116 casos denominados "cáncer vaginal primario" y aceptados para tratamiento, 5 eran formas raras, o sea 1 de cada 23 casos. Una enferma tenía un sarcoma botrioides, 2 tenían melanoepiteliomas y 2 leiomyosarcomas de la pared vaginal.

Los tumores malignos extraños del cuerpo uterino mostraron una proporción de 1 por cada 39 enfermas que tenían la habitual metropatía maligna. En muchos de ellos, fibromas uterinos habían experimentado alteración maligna. Hubo 20 casos en esta serie: 17 leiomyosarcomas, 1 corioepitelioma, 1 tumor mesodérmico mixto y 1 carcinosarcoma.

En 8 casos de la serie completa, cabe decir que se obtuvieron buenos resultados aunque con la excepción de los 2 hemangioendoteliomas, todas las lesiones correspondían a formas reconocidamente resistentes a la irradiación. A la luz de estas observaciones, sosténese que, si bien el principal ataque contra esos tumores extraños es quirúrgico, la irradiación puede suministrar paliación que vale la pena en los casos inapropiados para la operación.

DISCUSSION

Maurice Lenz, M.D. (New York, N. Y.):¹ Dr. Fricke and his associates have collected 27 interesting and unusual uterine and vaginal malignant growths among a total of over two thousand pelvic cancers treated at the Mayo Clinic between 1935 and 1944. They emphasize the rarity of the cancers under discussion, the fact that they are primarily surgical problems, and that x-ray and radium treatment was used only as a palliative or postoperative measure. They call attention to the radiosensitivity of hemangioendoteliomas and leiomyosarcomas.

The frequency of leiomyosarcoma of the uterus,

according to Corascaden, varies with the criteria used for its microscopic diagnosis. At the Presbyterian Hospital only 10 cases were encountered between 1938 and 1947 as compared to a total of 370 carcinomas of the cervix and 216 of the fundus seen in the same period. The criteria of malignancy in these 10 cases were microscopic evidence of invasion and metastasis. The percentage of uterine leiomyosarcoma could be raised to 12 per cent if the diagnosis were based on a variation in the size and shape of the cells instead of invasion and metastasis. The criteria used in the series just presented by Dr. Fricke evidently were similar to those employed at the Presbyterian Hospital.

Some endometrial sarcomas may be mistaken for

¹ Read by Dr. A. F. Rocco.

leiomyosarcomas of the uterus and these may be exceptionally radiosensitive. We treated one such case in a woman of thirty-two, who, three years after supravaginal hysterectomy, had extensive retroperitoneal spread of the growth, occupying all of the pelvis and most of the abdomen. A tumor x-ray dose of about 5,000 r in eleven weeks was administered, with complete disappearance of all clinical

evidence of sarcoma. Death occurred twelve years later from myelogenous leukemia, without recurrence of the retroperitoneal growth. The microscopic diagnosis of this tumor was spindle-cell fibrosarcoma or sarcoma of the endometrium.

The data presented by Dr. Fricke have added valuable information on the treatment of a rare yet important group of uterine and vaginal tumors.



A Topographic Approach to the Roentgenologic and Pathologic Examination of the Laryngopharyngeal Tumors¹

GILBERT H. FLETCHER, M.D.,² JACOB W. OLD, M.D.,³ and GEORGE S. LOQUVAM, M.D.⁴

IN MOST CASES, examination of laryngopharyngeal tumors is made by clinical means, limited to external palpation of the neck and direct and indirect laryngoscopy. Upon evaluation of the findings thus obtained the choice and extent of therapy are based. If the choice be surgical excision, the pathologic examination is usually limited to confirmation of the biopsy or, at most, sample checks of the margins of excision which appear grossly close to tumor.

In 1922, Coutard (3) introduced the use of lateral films of the neck, devising a technic which made apparent details of the soft-tissue structures of the laryngopharynx. This roentgenologic procedure was further developed during the subsequent years and the information thus obtainable is summarized in the classic works of Baclesse (1) and Leborgne (5). It was Leborgne (6) who thought of utilizing tomography to demonstrate frontal sections of the laryngopharyngeal structures.

These studies have allowed the development of a topographic roentgenologic approach which is considered by us to be an essential part of the complete examination of any laryngopharyngeal tumor. It has helped our understanding of the natural history of malignant disease in this location, and has made practical a classification based on the anatomic site of origin. This classification and the knowledge of the extension of the disease are a sound basis for the choice of treatment.

If a laryngectomy is performed, the surgical specimen can be studied by the same topographic methods, either to confirm or establish the site of origin of the tumor, as well as to add significant information which

may affect the prognosis or further treatment.

This method is, of course, supplemental to the classical methods of clinical examination and is applied to afford the most complete understanding of the case. Observations of immediate clinical importance are often made available during the course of evaluation which may alter either the choice or extent of therapy. Further, better determination of the probable site of tumor origin and hence of prognosis is often possible.

Palpation of the neck often yields only limited information as to the extent of a tumor. The presence or absence of metastatic deposits in lymph nodes can often be detected, but additional pertinent information concerning the extent of the primary disease is obtained only if this be far advanced. In such instances, a deformed thyroid cartilage, bulging in the pre-epiglottic region, or a fistula to the skin may be present. On the other hand, the thyroid cartilage may be invaded, or even perforated by extensions of tumor outside of the voice box, without any palpable enlargement. Massive invasion of the pre-epiglottic fossa may also escape detection by palpation. Such extensions of the primary malignant process can usually be demonstrated by radiologic methods.

Direct or indirect laryngoscopy can show only those tumors which are present on the mucous membrane surfaces of the laryngopharynx. Evaluation of the extent and location of the tumor may be seriously limited as a result of secondary changes in the tissues. Projecting polypoid tumor masses or edema (primary epiglottic) often prevent adequate visualization of the larynx.

¹ From the University of Texas, M. D. Anderson Hospital for Cancer Research, Houston, Texas. Presented at the Thirty-ninth Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 13-18, 1953.

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gopharyngeal structures; in such instances, ulceration of the laryngeal surfaces of the epiglottis can be missed, the vocal cords may not be seen, and the subglottic space, of course, cannot be visualized. Edema or invasion of the aryepiglottic fold and of the arytenoid regions often prevents visualization of the bottom of the piriform sinus. A fibrous web may form following laryngofissure and may cover active disease below. Endoscopic methods, of course, cannot determine pre-epiglottic fossa invasion or cartilage destruction, and the subglottic space is often poorly visualized.

MATERIAL PRESENTED

A series of 9 cases of primary laryngopharyngeal tumors is presented. These cases have been selected from a much larger number of similar examples observed and treated, because they portray most vividly the nature of the special information to be gained by radiologic examination, and because operative specimens and histologic sections of the total larynx are available to demonstrate the topographic distribution of tumor.

These cases form the basis for an adequate classification of tumors of the laryngopharynx and permit certain generalizations of clinical significance. The most obvious of these is the probable significance of the primary anatomic site of origin, since this can often be correlated with prognosis. The more complete pathologic study made possible by the large topographic sections of whole larynges allows for a fuller pathologic assessment of these tumors, in particular the nature and patterns of their extension.

TECHNIC OF TOPOGRAPHIC ROENTGENOLOGIC STUDY

The technics for roentgenologic examination have been described elsewhere in detail (4). A lateral soft-tissue exposure and tomographic frontal sections of the laryngeal region form the basis for the three-dimensional study of the larynx *in situ*.

The interpretation of the roentgen find-

ings rests on the evaluation of the density, size, and anatomic relationship of small soft-tissue structures. In order to diminish the causes of error, several principles must be rigidly followed. Magnification and distortion must be reduced to a minimum by the use of long target-screen distance and precise aiming at the desired level. The exposure factors depend upon the equipment available.

PREPARATION OF TOPOGRAPHIC HISTOLOGIC SECTIONS

The central purpose of topographic histologic studies is to demonstrate the nature and the extent of tumor invasion within the larynx; such a demonstration, properly executed, verifies and validates the preoperative radiologic impression and allows for a more adequate examination of the margins of surgical excision. The preparation of topographic sections is similar to the preparation of routine histologic sections, with special attention given to certain processing details in order that the purposes for which the sections are made may be realized.

The larynges are fixed *in toto* in 10 per cent formalin and decalcified, prior to the initial section, in formic acid sodium-citrate solution. The initial incision is crucial and is chosen by consultation between the radiologist and the pathologist, taking into consideration the clinical evaluation of the individual case. A flat plane of incision through the total larynx is effected by a single cutting stroke with a long knife (40 to 50 cm.). A thick (about 1 cm.) block is made from the desired region of the larynx and is dehydrated and paraffin-embedded by routine methods, with allowance of extra time in the various solutions for diffusion through the increased tissue bulk. Histologic sections are cut on a sliding microtome of moderate size (Spencer Model 860 in this laboratory) at 10 microns thickness and stained with hematoxylin and eosin. The histologic sections for the routine surgical report are made at the time of the original sectioning of the larynx.

DATA TO BE OBTAINED FROM TOPOGRAPHIC STUDIES

The major value of topographic studies lies in an accurate determination of the extension of tumor into contiguous structures. The choice of treatment is more

possible a classification of all tumors of the laryngeal region upon the basis of the regional extensions and anatomic site of origin of the tumor (7). Such an estimate allows planning for adequate therapy prior to its institution, whether this be irradiation or surgery (the so-called panlaryngec-

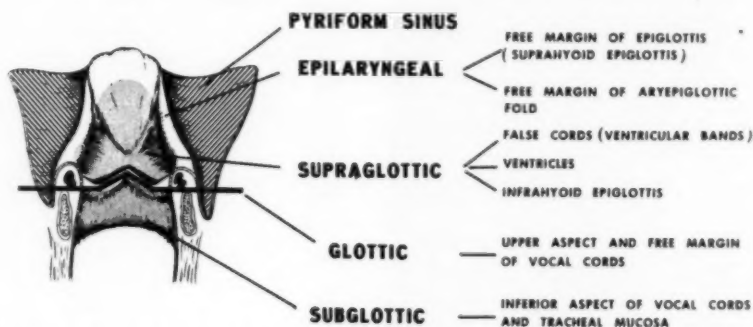


Fig. 1. Sketch of the open larynx illustrating the classification of laryngopharyngeal tumors by anatomical site of origin.

intelligent and definitive when a relatively true picture of the local tumor status is known. The roentgenologic studies permit assessment of the degree of extension in three important regions usually not apparent on clinical study of cases with limited involvement.

- (1) Ulceration of the epiglottis and invasion of the pre-epiglottic fossa (lateral soft-tissue film).
- (2) Destruction of the thyroid cartilage anteriorly (lateral soft-tissue film) or of the ala (tomogram).
- (3) Subglottic extension of tumor (tomogram).

In addition to evidence of extension, the degree of involvement and the location of the major bulk of tumor are often apparent radiologically, while clinical examination permits only the observation that tumor is present in the laryngeal region. This is especially true of tumors originating superior to the glottis (supraglottic) on the aryepiglottic folds or false cords or in the pharyngeal area (hypopharyngeal), which includes the piriform sinuses and pharyngeal mucosa regional to the larynx. The distinction made in this manner makes

tomy which includes excision of the hyoid bone is indicated especially in the supraglottic group). The true vocal cord is considered the pivotal level, since this location gives rise to tumors with the best prognosis; increasingly poor prognosis and difficulty of effective therapy are encountered

CLASSIFICATION OF LARYNGOPHARYNGEAL TUMORS BY ANATOMIC SITE OF ORIGIN (2, 7) (FIG. 1)

Three levels of origin are considered within the larynx itself:

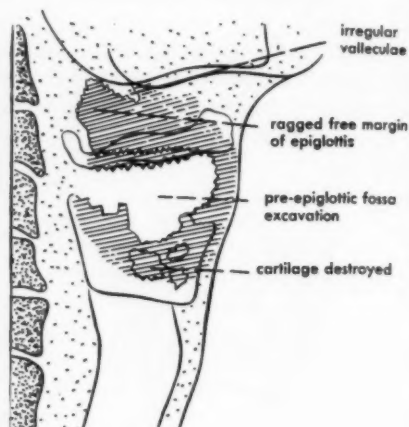
- (1) *Supraglottic*: ventricle, ventricular band (false cord), and laryngeal surface of infrahyoid epiglottis.
- (2) *Glottic*: superior surface or free margin of true vocal cords.
- (3) *Subglottic*: inferior surface of true cord or trachea.

Two levels above the supraglottic are distinguished as separate loci, due to definite differences in clinical course and response to therapy:

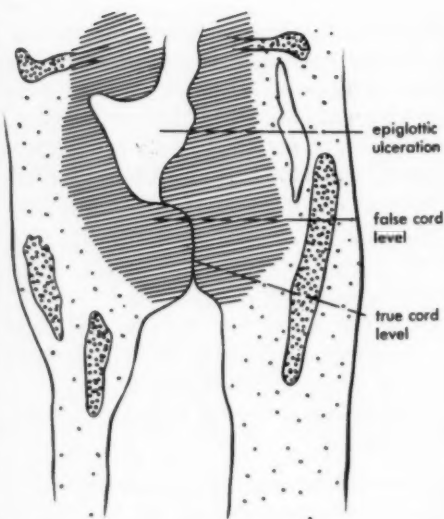
- (1) *Epilaryngeal*: suprahyoid epiglottis and free margin of the aryepiglottic fold, i.e. "brim" of the laryngeal vestibule.
- (2) *Piriform sinus*: bottom of sinus and sinus surface of aryepiglottic fold.

as the site of origin ascends, and difficulties in control of recurrence in the tracheal stoma arise as the site descends.

The large sections prepared from whole



A



B

Fig. 2. Case I.
(For legend, see opposite page.)

excised larynges allow an exact study of the extent of tumor within the larynx. This is used to validate the roentgenologic studies and evaluate the specimen more adequately. In these large sections extensions of tumor to surface margins of

excision have often become apparent which were not demonstrable in routine sections.

TUMOR EXTENSION AND INVASION

(1) *Ulceration of the Epiglottis and Pre-epiglottic Fossa Invasion* (demonstrable on

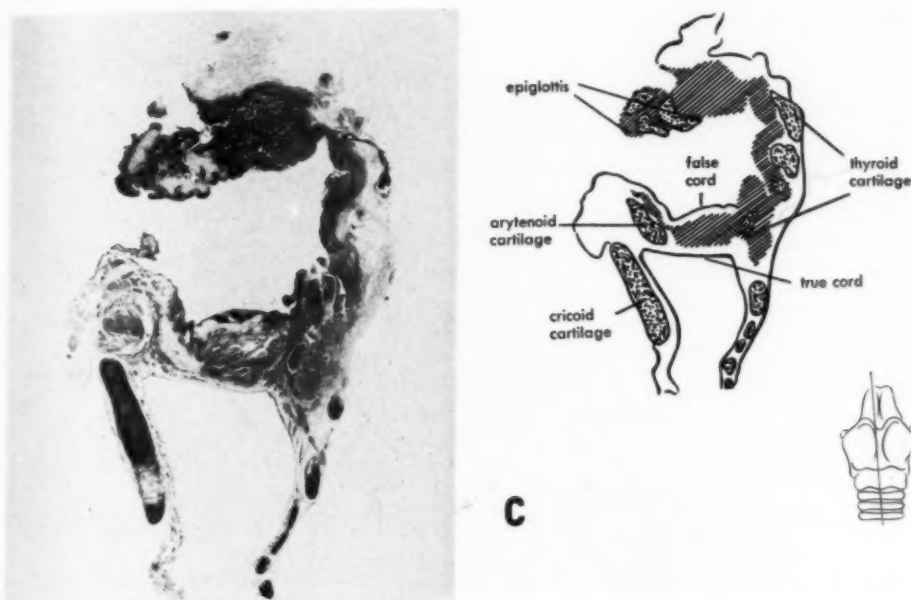


Fig. 2. Case I.

Clinical Findings: Both indirect and direct laryngoscopy show a markedly thickened epiglottis and edema of the left false cord with a papillomatous lesion on its posterior aspect. The true cords are edematous.

A. Lateral Soft-Tissue Roentgenogram: Ragged free margin of epiglottis with ulceration on the laryngeal surface extending into a large cavity in the pre-epiglottic space; complete destruction of the anterior aspect of the thyroid cartilage.

B. Tomogram: Marked thickening of the whole of the left hemilarynx with a polypoid mass on the left false cord; swollen right vocal cord; practically no subglottic extension.

Radiologic Impression: Extensive supraglottic tumor originating on the laryngeal surface of the epiglottis with marked pre-epiglottic invasion.

C. Pathologic Examination: The operative specimen shows the base and body of the epiglottis destroyed by ulcerating tumor which extends into an expanded pre-epiglottic fossa (primarily on the left) and into the left intrinsic larynx anteriorly. Sagittal section shows an excavated mass largely replacing the epiglottis, and thyroid cartilage anteriorly. **Topographic Histology:** Parasagittal section shows moderately well differentiated squamous-cell carcinoma infiltrating and replacing the epiglottis and infiltrating into the pre-epiglottic fat pad, almost to the plane of anterior excision and into the thyroid cartilage at the level of the vocal cords with destruction of cartilaginous substance.

Comments: Neither direct nor indirect laryngoscopy could demonstrate the ulceration of the epiglottis or, even less, the excavating pre-epiglottic fossa invasion. Characteristically, supraglottic tumors do not extend appreciably in the subglottic region. Extensive radiation therapy was given postoperatively in view of the supraglottic site of origin and extensions.

(This case is presented through the courtesy of Dr. Fred R. Guilford, E.N.T., Dr. Luther M. Vaughan, radiologist, and Dr. W. G. Brown, pathologist, Hermann Hospital, Houston, Texas.)

lateral soft-tissue roentgenogram): Tumors originating on the laryngeal surface of the epiglottis or somewhat more posteriorly on the laryngeal surface of the ary-epiglottic fold, as well as tumors primary on the ventricular band (false cord) or the anterior commissure, have a direct spread through the cartilage of the epiglottis into the pre-epiglottic fossa. The profile film best demonstrates this type of tumor extension, since the sagittal plane is visualized. Such films may show actual ul-

ceration of the epiglottis, bulging of the laryngeal surface of the epiglottis with lack of definition of the foot of the epiglottis, and widening of the pre-epiglottic fossa (Figs. 2A, 3A, 4A). These last two findings are pathognomonic of pre-epiglottic fossa invasion. Such evidences of tumor extension are often associated with an absence of calcification of the anterior aspect of the thyroid cartilage (almost always present in men of tumor age in the form of a "figure of 8"), and indicate that

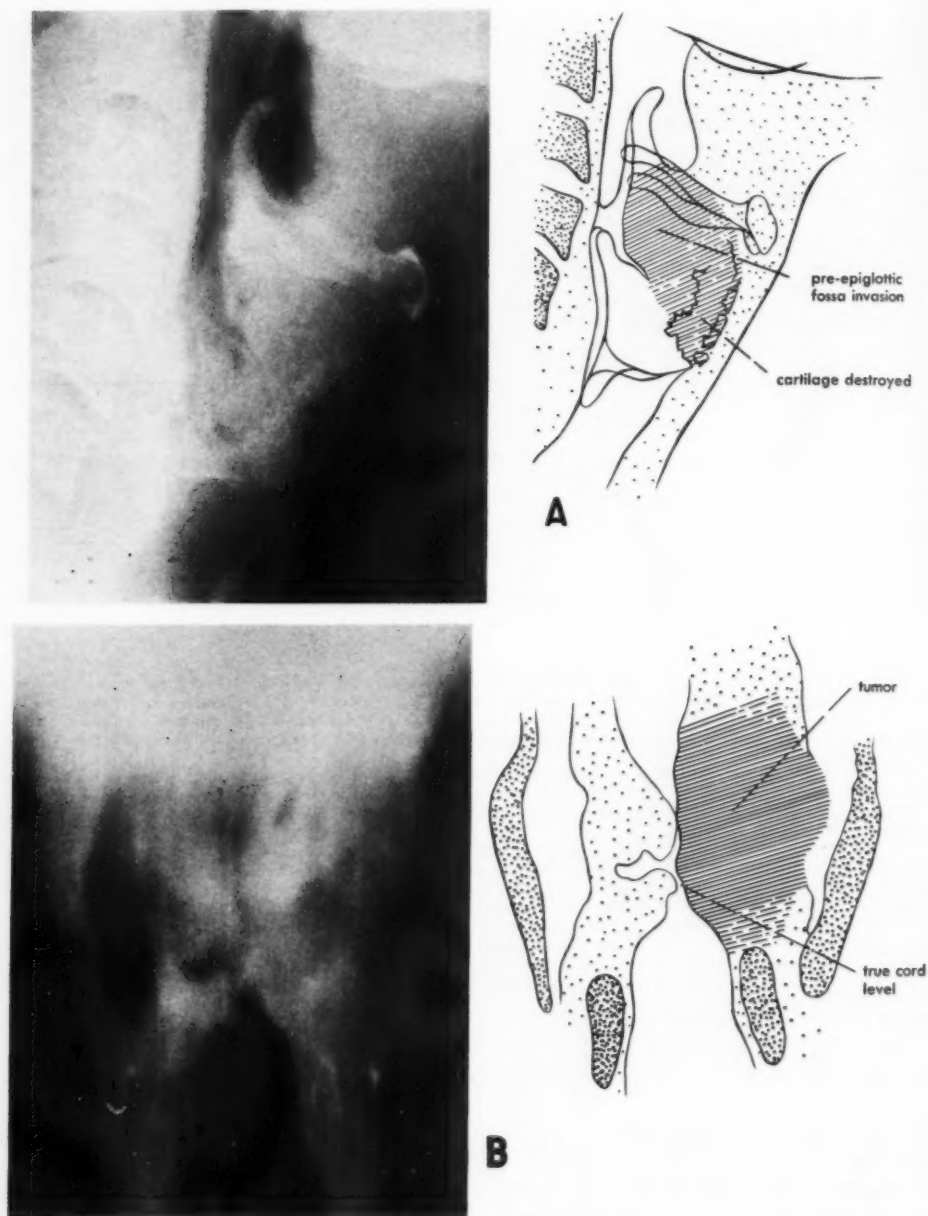


Fig. 3. Case II.
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this structure has been destroyed by the tumor (Figs. 2A, 3A, 4A).

When the lateral soft-tissue films show such findings and a laryngectomy has been performed, a sagittal or parasagittal section of the specimen should be made to

confirm the roentgenologic findings. Such sections will demonstrate the presence of pre-epiglottic invasion and show how close the tumor has extended to the anterior plane of excision in the surgical specimen. Occasionally, such preparations will show

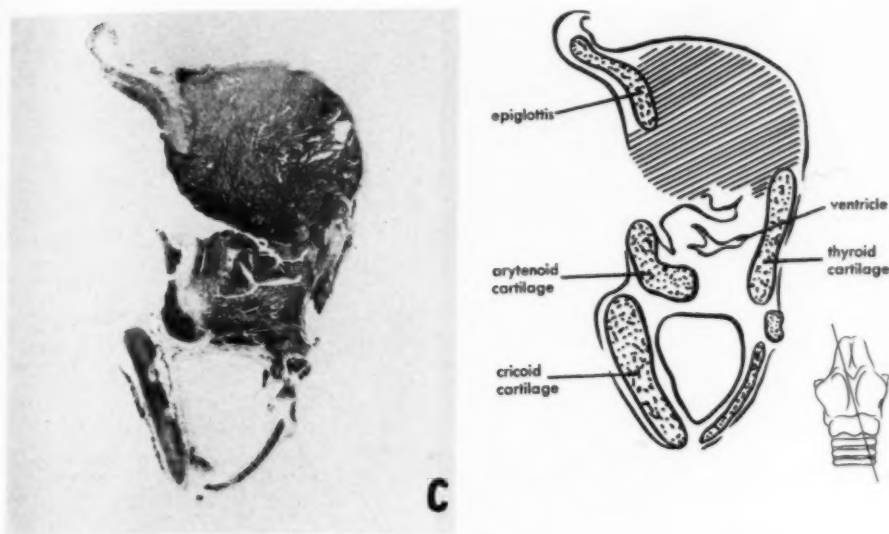


Fig. 3. Case II.

Clinical Findings: Laryngoscopic examination shows an ulcerating tumor on the laryngeal surface of the epiglottis extending into the left hemilarynx. Marked swelling of left aryepiglottic fold. Almost complete fixation of left arytenoid.

A. Lateral Soft-Tissue Roentgenogram: Posterior bulging of laryngeal surface of epiglottis; considerable widening of pre-epiglottic fossa; "figure of 8" cartilage pattern destroyed; diffuse opacity of glottic lumen.

B. Tomogram: Marked widening and distortion of aryepiglottic fold and supraglottic structures. Narrowing but no obliteration of the piriform sinus; minimal blunting of the left subglottic angle.

Radiologic Impression: Tumor of laryngeal surface of the epiglottis with extensive invasion of the pre-epiglottic fossa.

C. Pathologic Examination: The operative specimen is deformed in the superior part by a mass which fills the pre-epiglottic space, bulges posteriorly, and measures 5 cm. in diameter. Incision shows extension anteriorly, more to the right, with displacement and partial destruction of the base of the epiglottis and massive infiltration of the pre-epiglottic tissues. **Topographic Histology:** Parasagittal section shows a moderately well differentiated squamous-cell carcinoma destroying the superior margin of the thyroid cartilage and base of the epiglottis. The tumor growth is massive and is separated at the anterior plane of surgical incision by a thin intact fibrous sheet.

Comments: Radiologic examination shows an extensive supraglottic tumor originating on the laryngeal surface of the epiglottis with massive involvement of the pre-epiglottic fossa. Despite the extensive supraglottic tumor, there is no subglottic extension. This is an important point in the differential diagnosis between true vocal cord tumor and supraglottic tumor. The sections confirm the radiologic findings. Panlaryngectomy was performed, with extensive postoperative x-ray therapy; however, there was recurrence in the pre-epiglottic space six months later.

that the tumor has not been adequately excised, despite an apparent margin of clearance on examination of the specimen by routine methods.

The practical significance of such findings is apparent. With demonstration of pre-epiglottic fossa invasion or perforation throughout the epiglottis, a so-called panlaryngectomy (removal of hyoid bone and strap muscles) is indicated. If the involvement is massive, radical postoperative irradiation with heavier doses than usual in the pre-epiglottic region is also indicated (Cases I-III). Conversely, the absence of radiologic evidence of ulceration or

bulging of the foot of the epiglottis, or of widening of the pre-epiglottic region, indicates a circumscribed tumor, which is often amenable to radiation therapy alone.

(2) **Destruction of Thyroid Cartilage (demonstrable both on lateral soft-tissue roentgenograms and frontal tomograms):** The diagnosis of cartilage invasion can be made only on the basis of what seems to be a real disorganization in the calcification pattern of the thyroid cartilage. This pattern is normally very irregular, so that great caution must be exercised before inferring that there is destruction of cartilage due to tumor invasion.

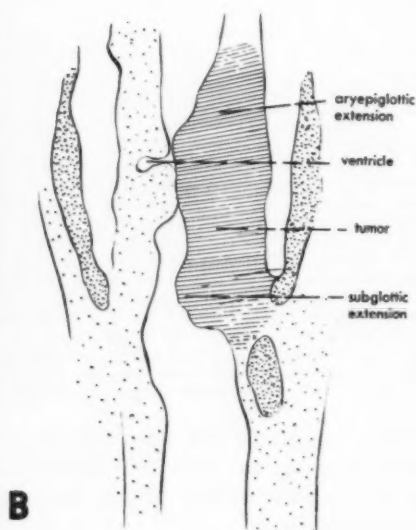
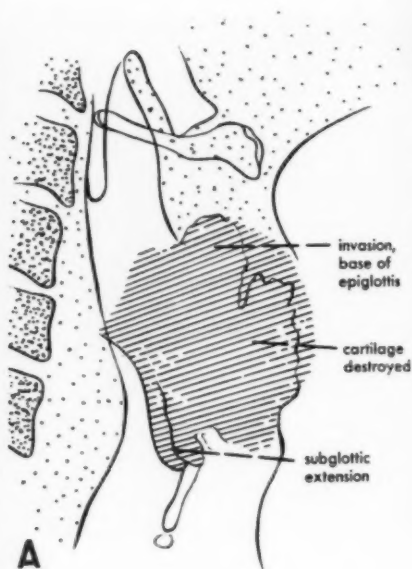


Fig. 4. Case III.
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Cartilage calcifications are far less extensive in females than in males. In the male group; the calcification in the anterior of the thyroid cartilage has the shape of the "figure 8" on the lateral films and is present in almost all patients above forty.

The absence of such pattern in this group of patients is pathognomonic of cartilage destruction. This finding is seen on the lateral soft-tissue roentgenogram (Figs. 2A, 3A, 4A).

The lateral wall of the piriform sinus is

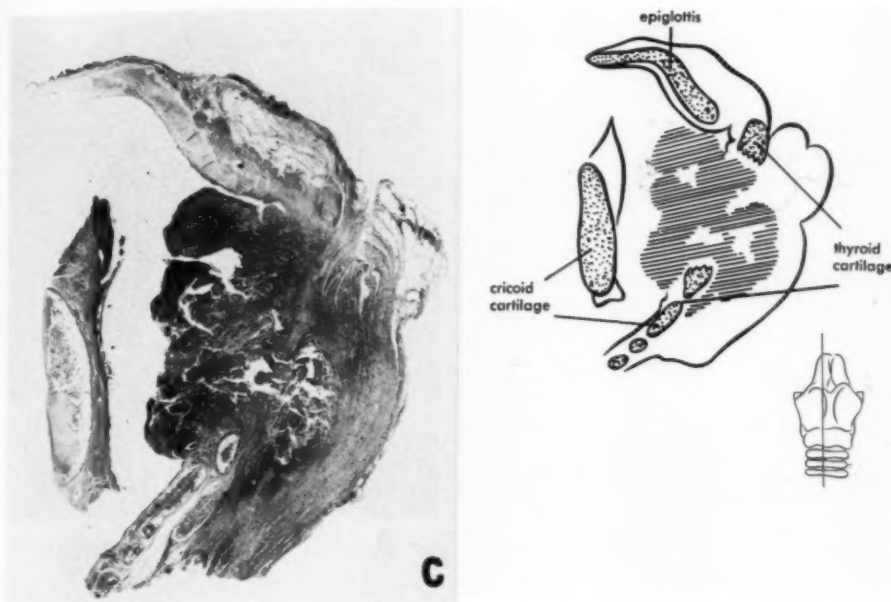


Fig. 4. Case III.

Clinical Findings: Ulcerating mass involving the entire left hemilarynx (false cord, ventricle, and true cord), with extension across anterior commissure and involvement of the anterior third of the right cord. Left hemilarynx fixed, right mobile.

A. Lateral Soft-Tissue Roentgenogram: Complete disappearance of the anterior "figure of 8" calcifications; extensive subglottic extension.

B. Tomogram: Considerable thickening of the left hemilarynx, with extensive subglottic extension; partial obliteration of the piriform sinus.

Radiologic Impression: True vocal cord tumor with extensive supra- and subglottic extensions and massive invasion of the anterior aspect of the thyroid cartilage.

C. Pathologic Examination: The operative specimen shows a granular bulky mass 4 cm. in greatest dimension, infiltrating the glottis and subglottic soft tissues on the left, with destruction of the left laryngeal landmarks; the tumor penetrates the left ala of the thyroid cartilage and infiltrates adherent strap muscles in this region. The muscles show a surrounding zone of reactive fibrosis. *Topographic Histology:* Sagittal section shows moderately well differentiated keratinizing squamous-cell carcinoma which obliterates the glottic structures and destroys the thyroid cartilage, with infiltration of the soft-tissues adherent to the anterior surface of the larynx. A surrounding zone of reactive fibrosis is present in the voluntary muscles in this region.

Comments: In view of the roentgen findings, two tracheal rings were removed. Extensive postoperative x-ray therapy was given, with the maximum tumor dose of 7,000 r in eight weeks to the pre-epiglottic fossa. However, recurrence in that region appeared seven months after completion of treatment.

formed by the ala of the thyroid cartilage, and the tomogram makes a cross section which is usually clearly defined. At times, on the lateral soft-tissue film, a very irregular mottling on the ala of the thyroid cartilage is strongly suggestive of tumor invasion, but it is primarily on the tomogram that one can diagnose cartilage destruction here (Fig. 10A). Extensive tumors of the laryngopharyngeal wall and piriform sinus or even true cord tumors can invade through the ala of the thyroid cartilage.

If laryngectomy is performed, confir-

mation of invasion of the thyroid cartilage is obtained and the likelihood of demonstrating tumor at the periphery of the specimen is enhanced by taking either frontal or horizontal cross sections, depending on the radiologic findings. At times, the diagnosis of adequate excision made on routine pathologic studies of only the resected edge of the mucous membrane surrounding the tumor will be changed by discovery of tumor at the surface of the operative specimen (Fig 10B). In such instances, postoperative x-ray therapy is imperative.

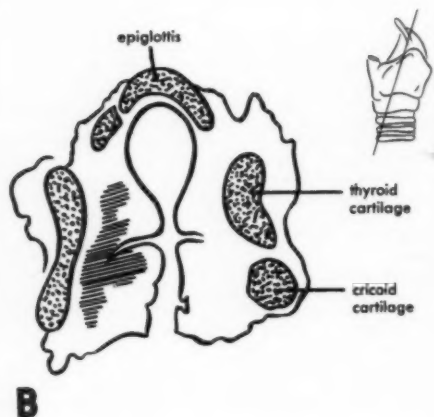
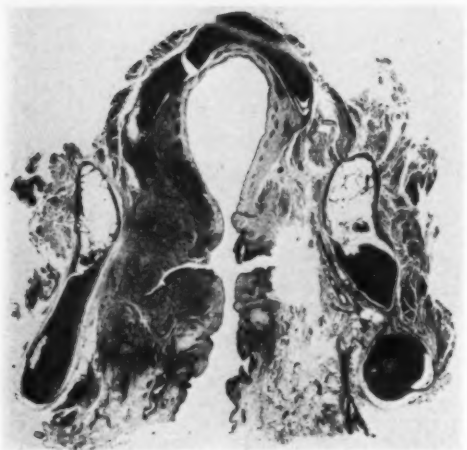
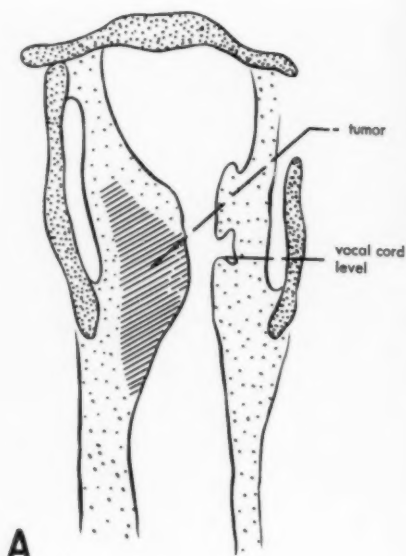


Fig. 5. Case IV.

Clinical Findings: Patient had x-ray therapy nine months previously for vocal cord tumor with partial fixation. Laryngoscopic examination now shows fixation and thickening of the right hemilarynx, but the mucous membrane appears normal.

Lateral Soft-Tissue Roentgenogram: Unrevealing.

A. Tomogram: Marked thickening of the right hemilarynx with complete obliteration of the ventricle. **Radiological Impression:** Despite an apparently normal mucous membrane, findings are strongly suggestive of underlying active disease.

B. Pathologic Examination: The operative specimen shows the right intrinsic larynx deformed by submucosal tumor, which fills the true and false vocal cords and extends approximately 1.5 cm. above and below the level of the vocal cords. One small area of ulceration is present on the right vocal cord. **Topographic Histology:** Frontal section shows moderately well differentiated squamous-cell carcinoma infiltrating the soft tissues of the intrinsic larynx in a submucosal position. The tumor extends sub- and supraglottically in this region and does not involve the overlying mucosa in this section.

Comments: The tomograms were the determining factor in the diagnosis of recurrence. The large section confirmed the supra- and subglottic extension, establishing the diagnosis of true vocal cord tumor.

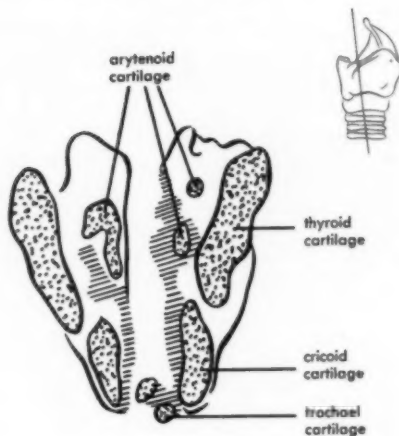
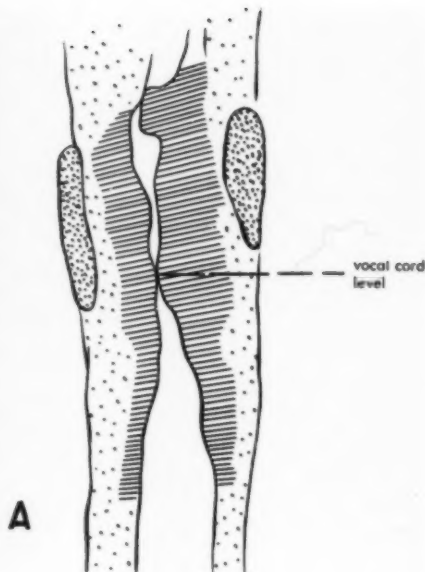


Fig. 6. Case V.

Clinical Findings: Laryngoscopic examination shows a greatly narrowed air space as the result of an extensive tumor occupying the whole vestibulum.

Lateral Soft-Tissue Roentgenogram: Unsatisfactory.

A. Tomogram: Massive disease extending from the entrance of the vestibulum of the larynx to several centimeters below the vocal cord level.

Radiologic Impression: Vocal cord tumor with massive supra- and subglottic extension.

B. Pathologic Examination: The operative specimen shows complete obliteration of the structures of the larynx bilaterally, with effacement of the true and false cords. The tumor is present as a roughened, finely granular plane surface occupying a moderately increased soft-tissue volume and extending to the aryepiglottic folds and to the level of surgical excision at the bottom of the third tracheal ring. The fourth tracheal ring, separately received, shows no evidence of gross tumor. **Topographic Histology:** Frontal section shows moderately well differentiated squamous-cell carcinoma occupying the total soft-tissue space along the internal wall of the larynx bilaterally. The bulk of tumor is not great but extends superiorly above the level of the vocal cords and inferiorly to the second tracheal ring. For technical reasons, the third tracheal ring is not present on this section.

Comments: The tomograms were the only source of information as to the massive subglottic extension, which was confirmed on the large section. Despite the removal of four tracheal rings, the patient had a recurrence on the posterior wall of the trachea, about 2 to 3 cm. below the stoma, within three months.

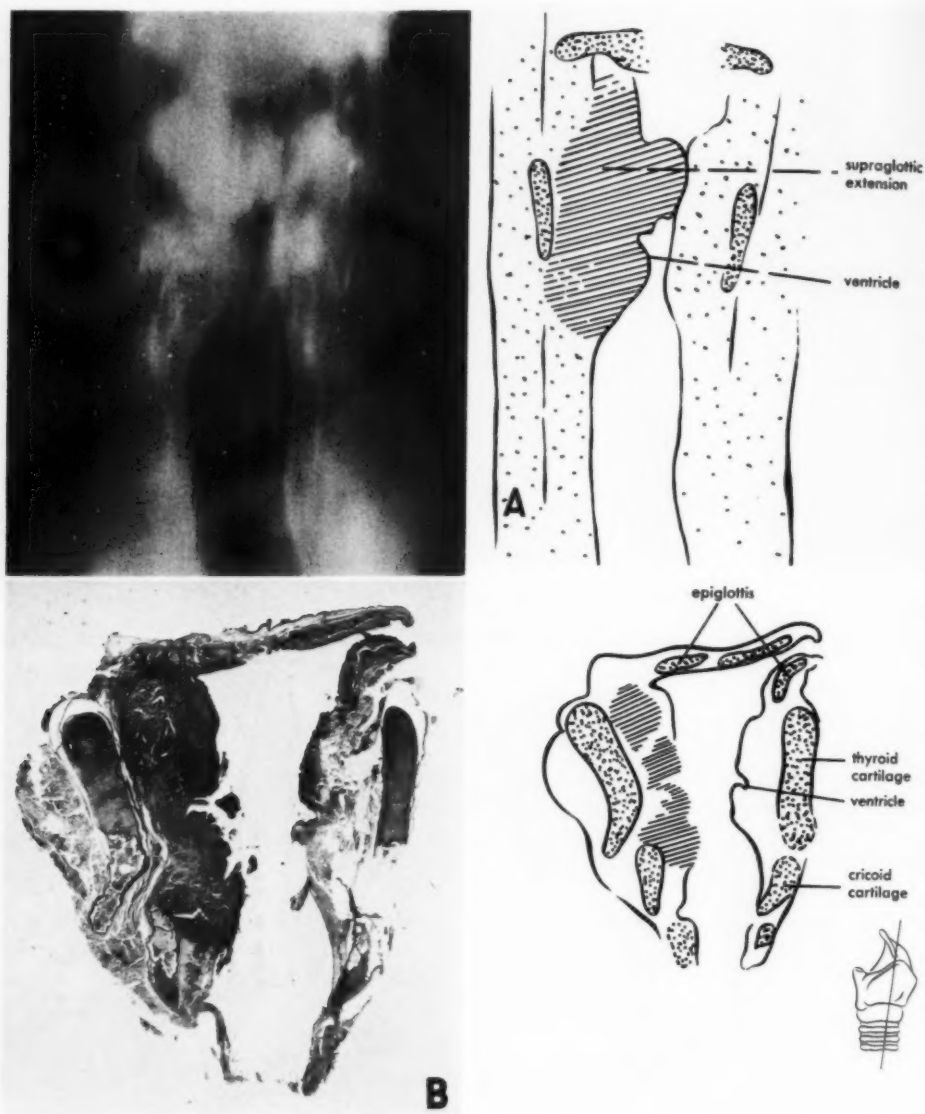


Fig. 7. Case VI.

Clinical Findings: Extensive lesion involving right hemilarynx; marked edema of right arytenoid. Visualization of lesion difficult. Biopsy specimen removed blindly. Questionable site of origin.

Lateral Soft-Tissue Roentgenogram: Unrevealing.

A. Tomogram: Lesions involving aryepiglottic fold, ventricular band, ventricle, and vocal cord, with subglottic extensions.

Radiologic Impression: Probable extensive true vocal cord tumor, in view of sub- and supraglottic extension.

B. Pathologic Examination: The operative specimen shows the right intrinsic larynx deformed by a granular tumor mass which extends superiorly to the anterior part of the aryepiglottic fold and elevates the right base of the epiglottis without extensive infiltration of the pre-epiglottic fossa. The tumor obliterates the right true and false vocal cords and extends inferiorly to the level of the mid-part of the cricoid cartilage.

Topographic Histology: Frontal section shows moderately well differentiated squamous-cell carcinoma most prominent inferiorly in the region of the vocal cord. The superior extension is a dense mass composed of epithelial tumor cells and a dense surrounding zone of tumor-induced fibrous connective tissue. Tumor is present near but not at the right anteroposterior margin of excision.

Comments: Tomograms revealed the presence of subglottic extension. The large sections showed that the obliteration of the subglottic space was due to tumor, corroborating quantitatively the tomographic findings. As tumor was close to the margin of excision, 6,000 r were given in seven weeks to the whole neck. No evidence of disease three years later.

(3) *Subglottic Extension (demonstrable on tomogram)*: Clinically, visualization of the subglottic space is often impaired or even impossible, and the presence or absence of subglottic extension cannot be ascertained. This occurs in cases which present exophytic tumors of the true vocal cord or grossly distorted supraglottic structures, as for instance a swollen, overhanging epiglottis or ventricular band. Lack of information as to the condition of the subglottic space is of serious import in two ways: the degree of subglottic extension determines the number of tracheal rings to be resected (Figs. 4B, 6A, 7A), and the absence or presence of subglottic extension is of considerable significance in the diagnosis of the anatomic site of origin (Cases VI and VII, Figs. 7 and 8).

Following laryngofissure, a fibrous web is often formed, replacing the removed cord. Active tumor growth may be present below the scar tissue and be effectively masked by the overhanging rigid scar tissue band; a false sense of security may obtain in such cases, since the mucosa of the supraglottic structures seldom becomes involved by extensions from tumor in this location. Following radiation therapy, the problem is sometimes similar (Case IV, Fig. 5A): one can see normal mucosa clinically beneath which, in the subglottic space, there is active disease.

On the tomogram, obliteration of the right-angled subglottic space and of the straight soft-tissue shadow along the lumen of the trachea are reliable signs of the presence of a tumor in the subglottic space. However, the opacity occasionally seen on the tomogram is not a true indication of the actual extent of tumor present in the specimen. Evaluation of the true amount of subglottic disease on the large tissue section is essential before the finding can be used as a criterion in the diagnosis of anatomic site of origin.

CLASSIFICATION BASED ON THE SITE OF ORIGIN

A crude classification of laryngopharyngeal tumors as operable and inoperable is

no longer adequate, since operable tumors may be radiocurable in a high percentage of cases, with saving of the voice, and tumors ordinarily considered inoperable are now, due to advances in surgical technique, often operable. An adequate classification should take into consideration not only operative criteria but also the natural history of the tumor and its predictable course. A classification of laryngopharyngeal tumors based on the site of origin is thus of more than academic interest, since predictable clinical behavior can be correlated with that particular site and has considerable bearing on the choice of treatment and the prognosis.

There are two currently utilized types of classification. The concept of the "intrinsic" and "extrinsic" larynx is used primarily in the United States, while a classification based on three levels of the laryngopharyngeal structures has originated in France.

There is no apparent agreement as to the exact meaning of the terms "intrinsic" and "extrinsic." Some authors consider as "intrinsic" those carcinomas which have not become inoperable by extending outside the confines of the endolarynx, while others use the term in reference to the primary site of a carcinoma, regardless of its subsequent extension. The criteria have varied with different authors. According to Hayes Martin (9), the line of demarcation between the "intrinsic" and "extrinsic" larynx is the free border of the false cord. Thus, tumors which arise from vocal cords or in the ventricles are "intrinsic" and all lesions which originate outside of that area are then "extrinsic." This concept places tumors of the ventricular band or laryngeal surface of the epiglottis in the same category with tumors of the piriform sinus, even though these two groups have a very different clinical course and prognosis.

A classification, to be useful, must allow the application of past experience to current clinical problems. Thus, by comparison of a particular current case to similar cases previously observed, one

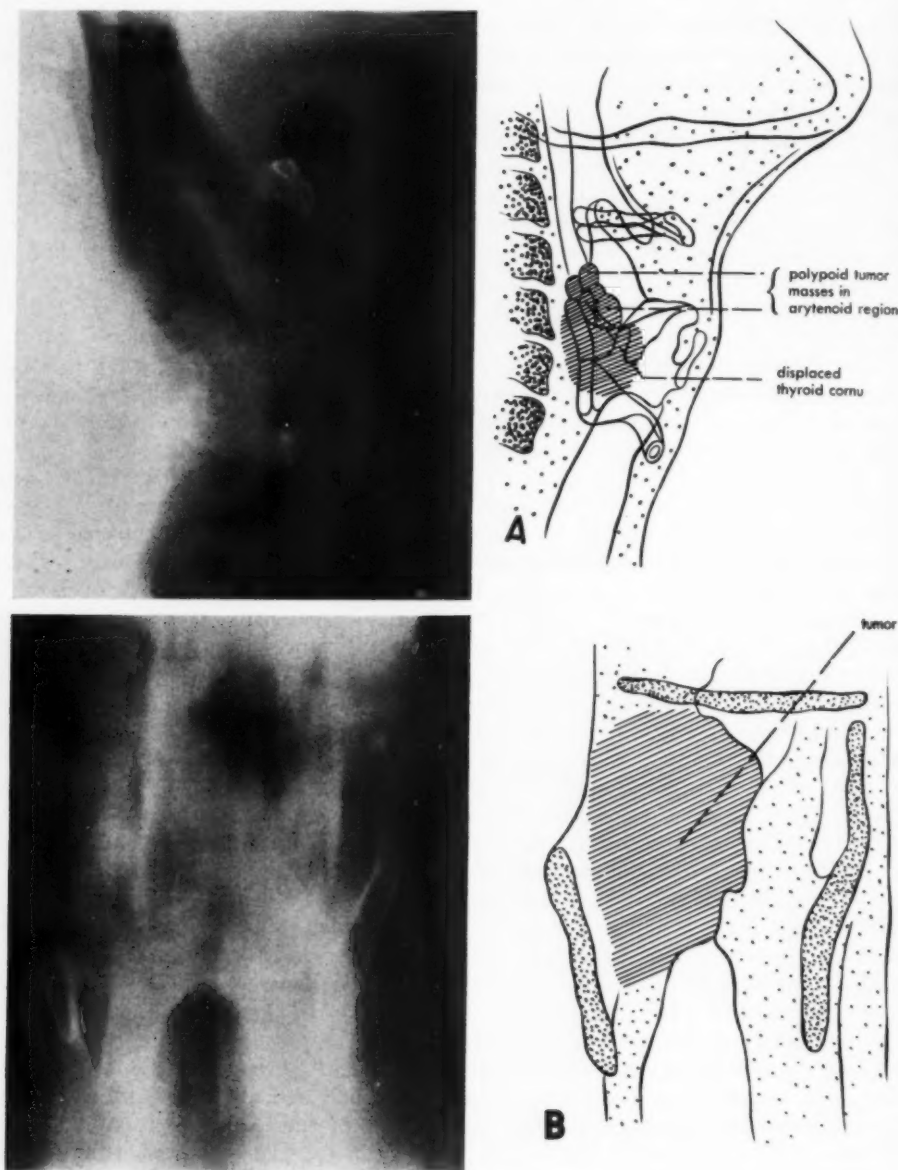


Fig. 8. Case VII.
(For legend, see opposite page.)

should be able to predict the probable clinical course and use it as a guide in treatment. For this reason, we utilize the French classification (Fig. 1); this is based primarily on three levels of origin, within the endolarynx, one at the "brim" of the laryngeal inlet, including the free

margins of the aryepiglottic fold and the tip of the epiglottis, and finally the irregular area of hypopharyngeal mucosa which covers the piriform sinuses. It is possible in most cases to locate accurately the site of origin to one of these areas and thereby have a basis for com-

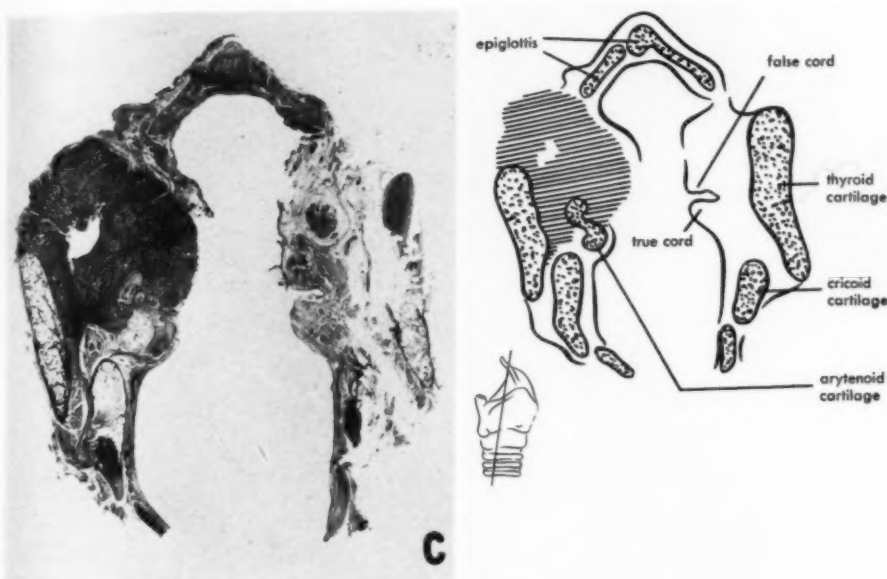


Fig. 8. Case VII.

Clinical Findings: Laryngoscopy shows a lesion involving the right hemilarynx and piriform sinus. The site of origin could be either on the true or false cords, with invasion of the piriform sinus or, conversely, with extension into the intrinsic larynx.

A. Lateral Soft-Tissue Roentgenogram: Polypoid masses at and above arytenoid regions and slight anterior displacement of one thyroid horn.

B. Tomogram: Marked thickening of the right hemilarynx with obliteration of piriform sinus; no subglottic extension.

Radiologic Impression: The absence of subglottic extension almost rules out a true vocal cord tumor. The posterior location on the lateral soft tissues points to a piriform sinus origin.

C. Pathologic Examination: The operative specimen shows the right piriform sinus to be obliterated by a granular mass which fills the sinus and displaces the right base of the epiglottis anteriorly and the right arytenoid cartilage medially and inferiorly. The right intrinsic larynx is deformed, and the structural details are effaced by edema, although the mucosal surface remains intact. **Topographic Histology:** Frontal section shows moderately well differentiated squamous-cell carcinoma filling the piriform sinus and displacing the arytenoid cartilage. Tumor is apparent at the superior-lateral margin of surgical excision.

Comments: The large section confirms the site of origin in the piriform sinus, with invasion of the laryngopharyngeal wall. It also demonstrates tumor at the margin of the plane of excision. In view of these two facts, postoperative x-ray therapy was given to the whole neck; minimum tumor dose 6,000 r in six weeks. No evidence of disease two and a half years after completion of treatment.

parison in cases which fall into one of several clearly defined groups.

If there were no means for differentiating the contiguous extensions of tumor from the true primary site of origin, such a refined classification would be useless for diagnosis except in tumors of limited extent. However, the patterns of extension from various primary sites are sufficiently characteristic to allow exact diagnosis in almost all cases.

Baclesse (2) has for many years stressed the fact that tumors originating on the vocal cords will usually show *both* subglottic and supraglottic extensions when they have become extensive. In contra-

distinction, tumors originating on the ventricular bands, laryngeal surface of the epiglottis or aryepiglottic fold, and piriform sinus become quite extensive with little or no subglottic extension (Figs. 2B, 3B, 8B).

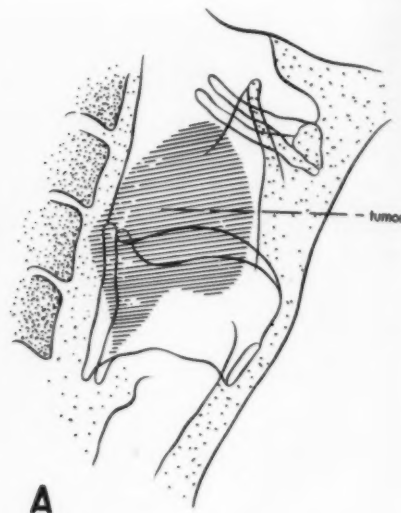
Extensive tumors originating in the endolarynx may, of course, infiltrate in the direction of the piriform sinus; such tumors must be differentiated from primary piriform sinus tumors with endolaryngeal extension. Definitive diagnosis of the primary nature of tumors which arise at the base of the piriform sinus is of particular importance, since their clinical behavior differs considerably from that of



Fig. 9. - Case VIII.
(For legend, see opposite page.)

tumors of the endolarynx which may invade the piriform sinus secondarily.

In the case of advanced tumors involving the vestibule, the existence of extensive subglottic extension favors the diagnosis



of true vocal cord tumors (Cases 3-6). In contradistinction, if there is practically no subglottic extension, one is most probably dealing with a primary supraglottic tumor (Cases I and II). Tumors of the piriform sinus are more likely to perforate early through the ala of the thyroid cartilage (Fig. 10A), and also to show less subglottic extension than extensive tumors of the vocal cord which have invaded the piriform sinus (Case VII). In addition, tumors of the piriform sinus extend posteriorly and so produce anterior displacement of one of the horns of the thyroid cartilage.

Tumors originating at the bottom of the piriform sinus always show filling of that space and marked widening of the laryngopharyngeal wall, whereas a tumor originating high up, or more particularly on the free margin of the aryepiglottic fold, is seen (on the lateral soft-tissue film and/or the tomogram) as a soft-tissue mass located at the site of this structure. In such tumors, not too advanced, the tomogram will show that the bottom of the piriform sinus is clear (4) (Case VIII).

A consideration of the data obtained by palpation, laryngoscopy, lateral soft-tis-

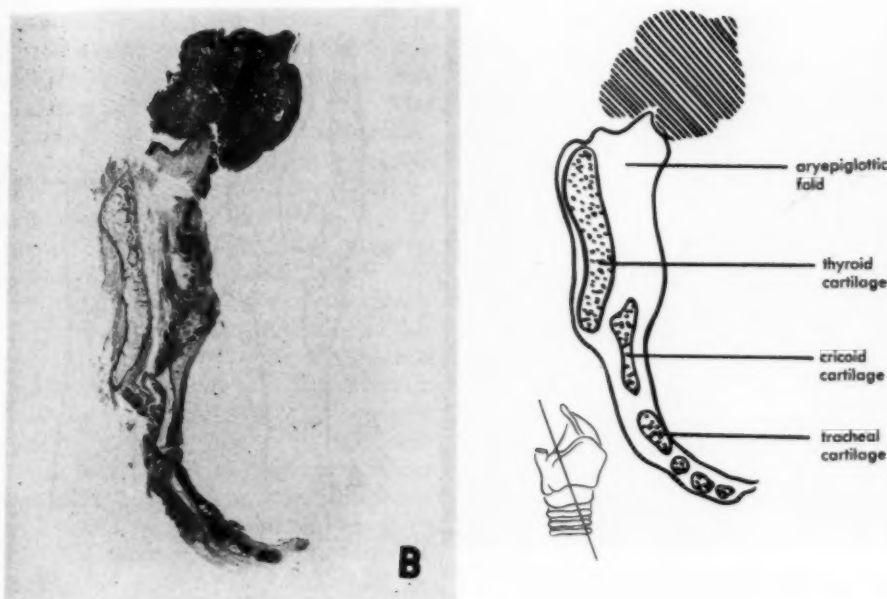


Fig. 9. Case VIII.

Clinical Findings: Large tumor with a smooth surface, occupying practically the entire laryngeal inlet, obscuring any view of the more inferior structures.

A. Lateral Soft-Tissue Roentgenogram: Large smooth mass filling the pharynx, apparently pedunculated, arising posteriorly. One thyroid horn is slightly displaced anteriorly.

Tomogram: No significant findings.

Radiologic Impression: Pedunculated tumor arising either on the aryepiglottic fold or posterior pharyngeal wall.

B. Pathologic Examination: The operative specimen shows a bulky ovoid mass, 4 cm. in greatest diameter, arising on a peduncle on the free margin of the right aryepiglottic fold. The tumor is molded and faceted by contiguous structures but does not infiltrate tissue except in the region of the peduncle. *Topographic Histology:* Frontal section of the right hemilarynx shows a tumor mass situated above the aryepiglottic fold; the peduncle is not included in this section.

Comments: There are two levels of origin of tumors of the piriform sinus: at the bottom and close to the margin of the aryepiglottic fold. Curability either by surgery or x-rays is higher in the latter variety. The original pathological report did not describe accurately the site of origin. The diagnosis was established on the large sections cut according to x-ray findings.

sue films, and tomograms will permit a diagnosis of tumor extension as well as the anatomic site of origin in a high percentage of cases. Even with the utilization of diagnostic roentgenologic technics, however, a definitive diagnosis is not always possible; thus, when a laryngectomy is performed, the confirmation or establishment of diagnosis by topographic study of the excised specimen is of direct clinical value in determining prognosis and the possible value of postoperative radiation therapy. Such pathologic studies define the character of the tumor, establish its bulk and degree of extension, and allow more accurate evaluation of the margins of excision.

The variations of biologic behavior of tumors originating at different anatomic sites make definitive diagnosis a matter of prime importance. Tumors primary on the true vocal cord tend to be of the keratinizing type, and less than 10 per cent show evidence of metastasis at the time of clinical diagnosis. In addition, metastases which appear following excision of the primary lesion are of slow development and spread in a manner quite similar to that observed in the keratinizing squamous-cell carcinomas of the lip and oral cavity. Thus, postoperative radiation therapy is not indicated unless examination of the excised specimen shows tumor near or at the margin of excision, and radical

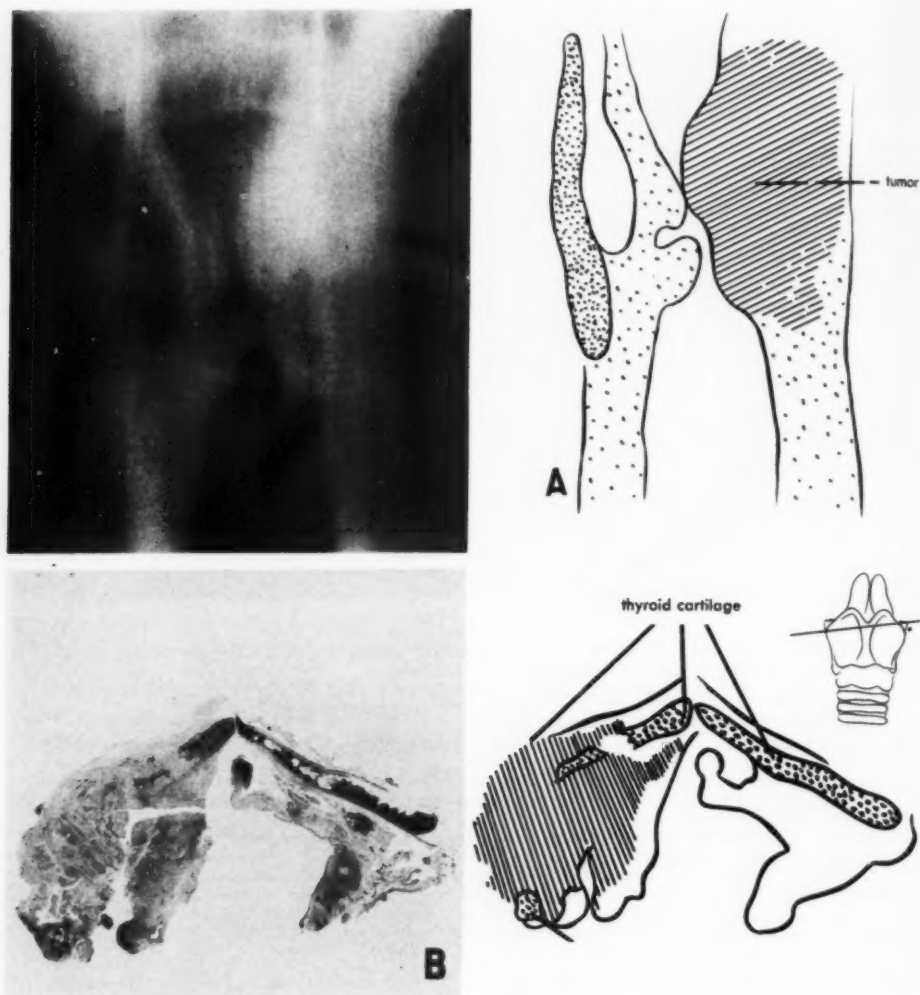


Fig. 10. Case IX.

Clinical Findings: Laryngoscopic examination shows a large hypopharyngeal mass involving the posterior and left lateral wall, bulging into the larynx to overlap the left cord, which could not be seen. The left arytenoid and aryepiglottic fold are involved in this mass. It cannot be determined from what site this tumor arose.

Lateral Soft Tissue Roentgenogram: Unsatisfactory.

A. Tomogram: Considerable widening of left hemilarynx with obliteration of piriform sinus. The whole left side forms one large soft-tissue mass which seems to go further laterally than the location of the thyroid ala, indicating that this structure is involved by tumor.

Radiologic Impression: Extensive tumor, probably arising in the piriform sinus.

B. Pathologic Examination: The operative specimen shows the left piriform sinus obliterated and filled by granular tumor which infiltrates and destroys thyroid cartilage laterally, forming a lateral bulging mass. The tumor infiltrates the lateral wall of the aryepiglottic fold and displaces the intrinsic larynx medially. **Topographic Histology:** Cross section shows moderately well differentiated squamous-cell carcinoma infiltrating and destroying the thyroid cartilage. Tumor is present at the lateral margin of surgical excision.

Comments: The large cross sections established the exact degree of extension and the presence of tumor at the surgical plane of excision. Massive recurrence within three months along the left pharyngeal wall.

neck dissection is the treatment of choice if metastatic tumor subsequently appears in the lymph nodes of the neck. In con-

tradistinction, tumors which arise at the supraglottic level, whatever may be the degree of local extension, show a marked

tendency to metastasize widely, and as many as 40 per cent of cases may show evidence of metastatic tumor at the time of diagnosis of the primary lesion. This characteristic of diffuse tumor dissemination is so marked that postoperative radiation therapy is indicated to sterilize possible lymphatic spread even though an apparently adequate margin of surgical excision is seen in the excised larynx and there is no palpable evidence of metastasis to the lymph nodes of the neck (8). In this instance, as in primary tumors of the tonsil or nasopharynx, radical neck dissection is not so likely to be a successful therapeutic measure. Tumors primary on the aryepiglottic folds or in the piriform sinus show similar behavior in their tendency to diffuse, widespread lymphatic involvement. The former, *i.e.*, those tumors originating on the aryepiglottic fold or high in the piriform sinus, are often radio-curable, whereas in those originating at the bottom of the piriform sinus radiotherapy yields very poor results.

The group of tumors originating in the supraglottic region, epilaryngeal area and piriform sinus, have been unsuccessfully treated by either radiotherapy or surgery alone. It is a practice at the M. D. Anderson Hospital to treat routinely all such tumors primarily by panlaryngectomy (if at all feasible), followed by heavy postoperative irradiation. There are reports in the literature (8) indicating that this approach yields better results. The experience of this Institution, although limited, substantiates the impressions reported from other centers.

SUMMARY

Nine selected cases of primary laryngopharyngeal tumors are presented with roentgenograms and topographic histologic sections of the excised larynges. These cases were chosen to illustrate the principles of roentgenologic evaluation of tumor location and extension; topographic histologic studies indicate the accuracy and limitations of the method.

A classification of laryngopharyngeal tumors according to the anatomic site of origin is correlated with prognosis and evaluation of therapy.

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SUMARIO

Aborde Topográfico al Examen Radiológico e Histopatológico de los Tumores Laringo-Faríngeos

Preséntase una serie de 9 casos de tumores laringo-faríngeos primarios para ilustrar los principios de la justipreciación roentgenológica de la localización y extensión de los tumores, con estudios histológicos topográficos que indican la exactitud y las limitaciones de este método. Los

estudios radiológicos comprenden radiografías laterales de los tejidos blandos y cortes frontales tomográficos de la región laríngea. Los estudios histológicos topográficos basados en cortes totales de la laringe sirven para comprobar la impresión radiológica preoperatoria y permiten un

examen más exacto de los bordes de la resección quirúrgica.

Preséntase una clasificación de los tumores laringo-faríngeos, tomando en consideración tres niveles distintos como puntos de origen en la laringe misma—

supraglótico, glótico y subglótico—y dos niveles más arriba del supraglótico, a saber, el epilaríngeo y el seno piriforme. Esta clasificación permite predecir el comportamiento clínico, el cual guarda una relación importante con el tratamiento.

DISCUSSION

Juan A. del Regato (Colorado Springs, Colo.): I find nothing in this paper with which I disagree. Dr. Fletcher has presented us with an additional example of his thoroughness. The radiographic study of the pharynx and larynx, both normal and pathologic, is the one contribution of radiotherapy to the field of radiodiagnosis, and its emphasis is well justified, for this is a chapter of radiodiagnosis in which radiodiagnosticians seldom show much interest.

If a man is deprived of a patient that he could have treated successfully with radiotherapy, he does well to pick up the surgical specimens to examine them as a surgical pathologist should, to compare his findings with his clinical and radiographic impressions, and to theorize as to how those patients should be treated. I believe that the author deserves to be congratulated for having done this to advantage.



The Calculation of Rotation Therapy Tumor Doses at 250 Kv. by Means of the Transmitted Dose Rate¹

ROBERT ROBBINS, M.D., and JEAN MESZAROS, M.S.

WHEN WE BEGAN to use rotation therapy at 250 kv. early in 1952, dosage determination methods by Hawley (1), Nielsen (2), and by Kligerman, Rosen and Quimby (3) were available. We adopted the method of the latter group, and it re-

of rotation. We set out to confirm the validity of this system for 250-kv. radiation.

The physical arrangement of the rotation chair, x-ray tube, and transit chamber are shown in Figure 1. The x-ray machine is operated at h.v.l. 1.7 mm. Cu, at a

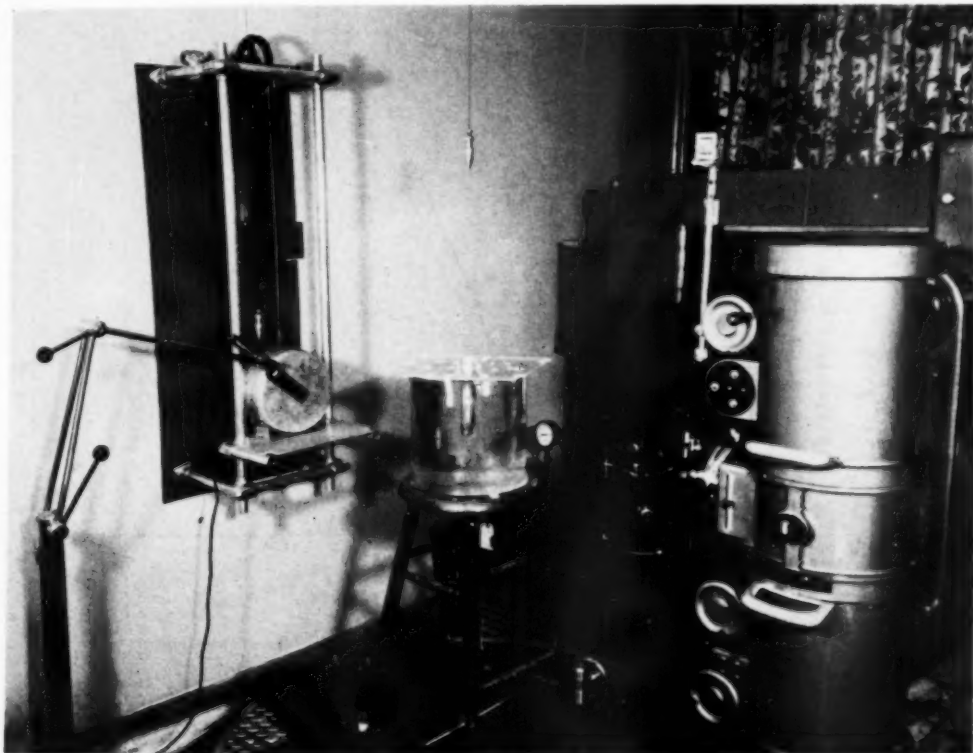


Fig. 1. Arrangement of rotation chair, x-ray tube, and transit chamber.

mains our basic method of dose assessment to date. A short time later, Wachsman (4) suggested the measurement of the dose rate of the transmitted radiation as a measure of the tissue dose at the axis

target-axis distance of 85 cm. The transit detector consists of a Victoreen Radocon with a 25-c.c. thimble chamber placed in the front surface of a presdwood phantom at 150 cm. from the target. A condenser

¹ From the Department of Radiology, Temple University Medical School and Hospital, Philadelphia, Penna. Presented at the Thirty-ninth Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 13-18, 1953.

The clinical application of the material reported was supported in part by a grant from the Philadelphia Division of The American Cancer Society.

r meter chamber of equally high sensitivity, such as the Victoreen 2.5-r chamber, would be satisfactory in a similar presdwood phantom, which we considered would minimize differences in the amount of scatter picked up from objects around the transit chamber in different rotation therapy

These studies were repeated for a range of portal areas, for elongated portals, and for non-central tumors, since these gave values which did not fall on the curves for central tumors. Further, the density of the phantom was changed by adding paper and air, bone, etc.

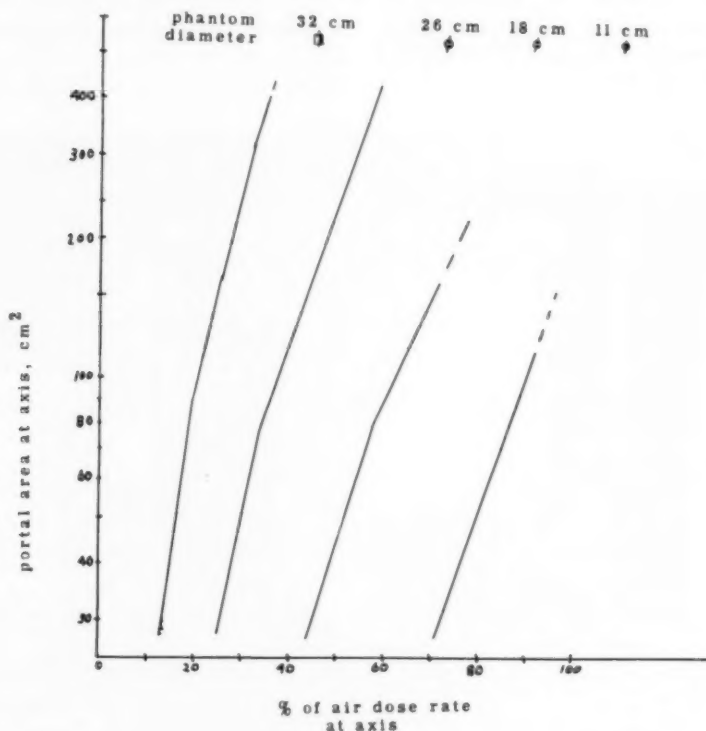


Fig. 2. Experimental values of per cent air dose rate at axis, for various portal areas and phantom thicknesses.

rooms. A 25-r Victoreen chamber was used in a plastic jacket for making the axis measurements in water phantoms of various shapes and sizes. All measurements were expressed as per cent of the air dose rate at the axis or transit positions, as appropriate.

Measurements were made simultaneously of axis and transit dose rates in air and at the center of a series of water phantoms, ranging in diameter from 11 to 35 cm., and in a series of elliptical base phantoms of equal base areas but with diameters in ratios of 1:1, 3:2, and 2:1.

RESULTS

Figures 2 and 3 show the variation, in per cent of air dose rate with portal area, with thickness of phantom as parameter, at the axis and transit positions respectively. From these curves, a family of curves was drawn (Fig. 4) relating the percentage air-dose rates at the axis and at the transit positions for various areas.

The relationship shown was demonstrated to be valid for the elliptical phantoms (*i.e.*, to be independent of body shape), and for phantoms containing water and air or water and bone.

Observations on the effect of elongated portals on tumor dose are in agreement with those of Clarkson (6), and this correction should be applied for portals whose sides differ in length by a factor of 2 or more. This situation is not often encountered in our department.

The corresponding axis dose rate expressed as per cent of axis air dose rate is found for the appropriate area at the axis of rotation, and multiplied by the air dose rate at the axis, and by the time of treatment, to give the tumor dose at the axis. If the axis is not at the center of the body section,

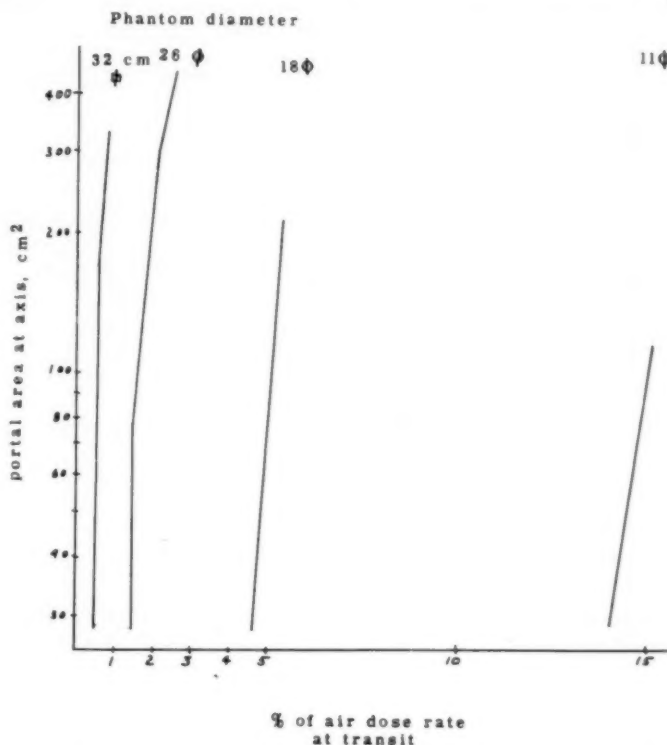


Fig. 3. Experimental values of per cent air dose rate at the transit chamber, for the same portal areas and phantom thicknesses as in Fig. 2.

When the axis of rotation is not at the center of the phantom, the axis and transit dose rates are higher than with a central axis of rotation, and here, too, a correction factor must be applied. This factor varies with the degree of eccentricity of the tumor and the thickness of the phantom. The correction factors have been measured experimentally, as shown in the inset of Figure 4, and calculated, as shown in Figure 5. These values are in reasonable agreement.

In use, the transit dose rate is obtained and expressed as per cent of transit air dose

(or if the portal elongation is greater than 2), the tumor dose is multiplied by the appropriate correction factors.

For example, if the transit dose rate is 2 per cent of the air dose rate at the transit position, for a portal area of 30 cm.² and a centrally placed tumor, Figure 4 gives an axis dose rate of 28 per cent of the air dose rate at the axis. However, if the axis is 6 cm. from the center of the body, the insert in Figure 4 gives a correction factor of 1.17, so that the value

$28 \text{ per cent} \times 1.17 = 32 \text{ per cent}$ should be used.

THEORETICAL CONSIDERATIONS

A theoretical approach was also undertaken, with analysis of the empiric data in terms of half-value layer, target-axis distance, target-transit distances, etc.

law as well. The standard depth dose curves must therefore be modified by removing the inverse-square factor (3, 5). Where this is done, the resulting curve turns out to be exponential over a large range (except for the initial portion of the

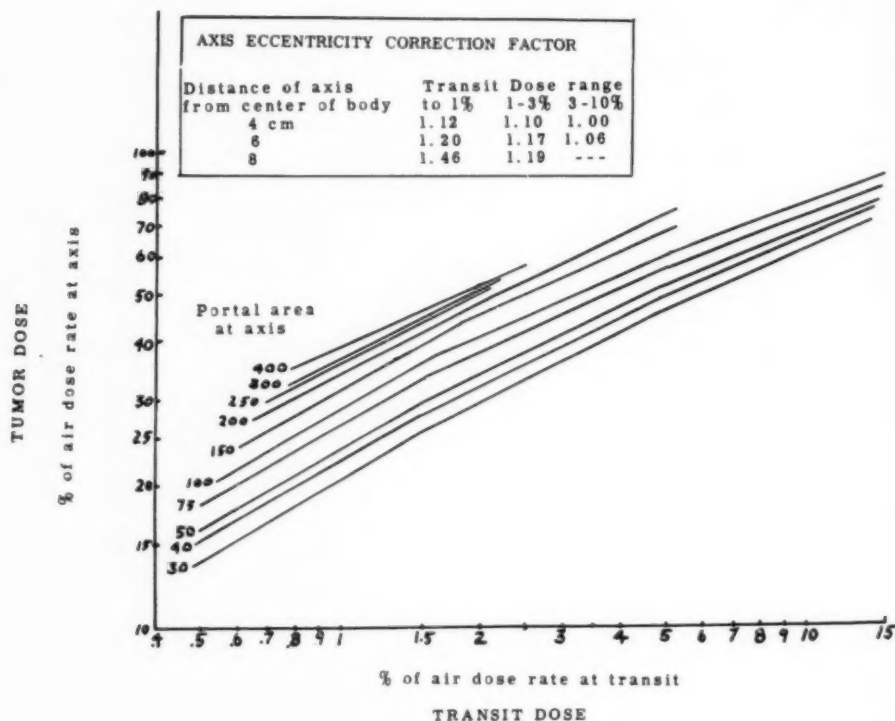


Fig. 4. Transformation of Figs. 2 and 3 so as to relate per cent air dose rates at axis and transit positions with portal area as parameter.

This was done in the hope that a generalization of the method would allow use of the system in other institutions without the necessity of carrying out the laborious experimental work.

The standard depth-dose curves relate changing dose rate with depth in tissue, and include effects of absorption, scatter, and attenuation due to distance (inverse-square law). Rotation therapy dosimetry differs from that of conventional therapy in that the tumor remains at a fixed distance from the target during rotation, so that changes in dose rate are due only to absorption and scattering, and *not* to the inverse-square

curve). It may be expressed by the relation

$$Pe^{-\mu d} \quad (1)$$

where μ is the slope of this curve and P is the zero depth intercept of this curve.

In rotation therapy, the cross section of any part may be considered as equivalent to a circle of equal area, as shown in the diagram in Figure 5.

The ratio of the per cent of air dose rate obtained at the axis and at the transit position is A/T .

$$A = Pe^{-\mu d} \quad (2a)$$

is the average value of the depth dose

$Pe^{-\mu d}$ received by the tumor for each of twelve 30° sectors of rotation, where d varies with each sector unless the tumor is at the center of a circular body cross section.

The average value of the transit dose received by the transit ionization chamber for each of the 12 sectors is

$$Qe^{-\mu'(d+p)} \quad (2b)$$

where μ' is the zero area absorption coefficient for the primary radiation. This expression requires that no photon scatter from the patient reach the transit chamber, but that only primary radiation reach the chamber. Q is the factor for back-scatter from the transit chamber phantom. It should approach the conventional back-scatter factors if the chamber is small and carefully embedded in a large phantom, and if no photon scatter from the patient reaches the transit chamber.

$$\frac{A}{T} = \frac{\overline{Pe^{-\mu d}}}{Qe^{-\mu'(d+p)}} \quad (3)$$

where from Figure 5

$$\left. \begin{aligned} d &= (-a \cos \theta + \sqrt{r^2 - a^2 \sin^2 \theta}) \\ (d+p) &= 2 \sqrt{r^2 - a^2 \sin^2 \theta} \end{aligned} \right\} \quad (4)$$

Theoretically, the average values for A/T may be found by integrating

$$\frac{A}{T} = \frac{\int_0^{2\pi} Pe^{-\mu d} d\theta}{\int_0^{2\pi} Qe^{-\mu'(d+p)} d\theta} \quad (5)$$

where d and $(d+p)$ are given in equation (4). In practice, the integration is done graphically by the 12-sector method.

Axis Eccentricity Correction Factor: Since the curve is drawn for circular phantoms, the correction factor to be applied to the axis dose for an eccentrically located axis of rotation is

$$C = \frac{A_e}{T_e} \div \frac{A_e'}{T_e'} \quad (6)$$

where A_e'/T_e' is the relation given by the transit dose curves at the point where T_e is measured, and A_e is the true axis dose.

$$\frac{A_e'}{T_e'} = \frac{Pe^{-\mu R}}{Qe^{-\mu' 2R}} \quad (7)$$

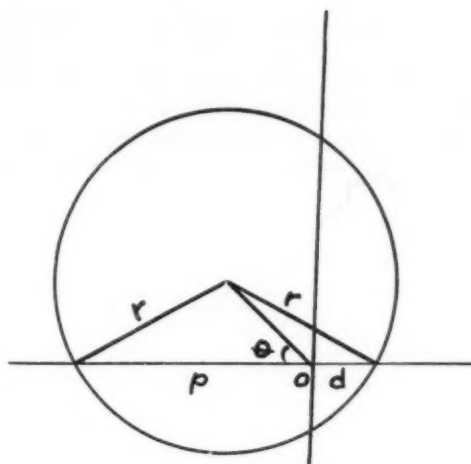


Figure 5

o = Axis of rotation. d = "Tumor" depth. $(d+p)$ = Thickness of tissue in front of transit chamber. r = Effective radius of part. θ = Angle of rotation.

where R is the effective radius, as defined by

$$Qe^{-\mu' 2R} = |Qe^{-\mu'(p+d)}| = T_e' = T_e \quad (8)$$

Then

$$C = \frac{\overline{Pe^{-\mu d}}}{|Pe^{-\mu R}|} = \frac{A_e}{A_e'} \quad (9)$$

where $\overline{Pe^{-\mu d}}$ is found experimentally or by graphic integration and $|Pe^{-\mu R}|$ is found from the transit dose curves for the transit dose value actually measured.

EVALUATION

The relationship given above (equation 3) for the axis-transit dose relationship fits the experimental values to better than ± 10 per cent for all except the largest phantoms and portal areas, where the deviations are greater. This is interpreted as meaning that some photon scatter from the patient reaches the transit chamber under these circumstances (see equation 2b, above).

The eccentricity correction factor given by relationship (equation 9 above) also deviates from the experimentally derived correction factor by less than 20 per cent except for the largest phantom and portal areas, for the same reason.

We believe that a transit detector which would satisfy the condition imposed in equation 2b, namely, one which will not detect photons scattered from the patient, will decrease the above deviations. Such a detector might be a well collimated

ing a thorax, a pelvis, and an elliptical water phantom of dimensions reasonably close to one another. Particularly interesting is the demonstration of rising transmission for the thorax, as the beam enters the oblique and lateral positions even

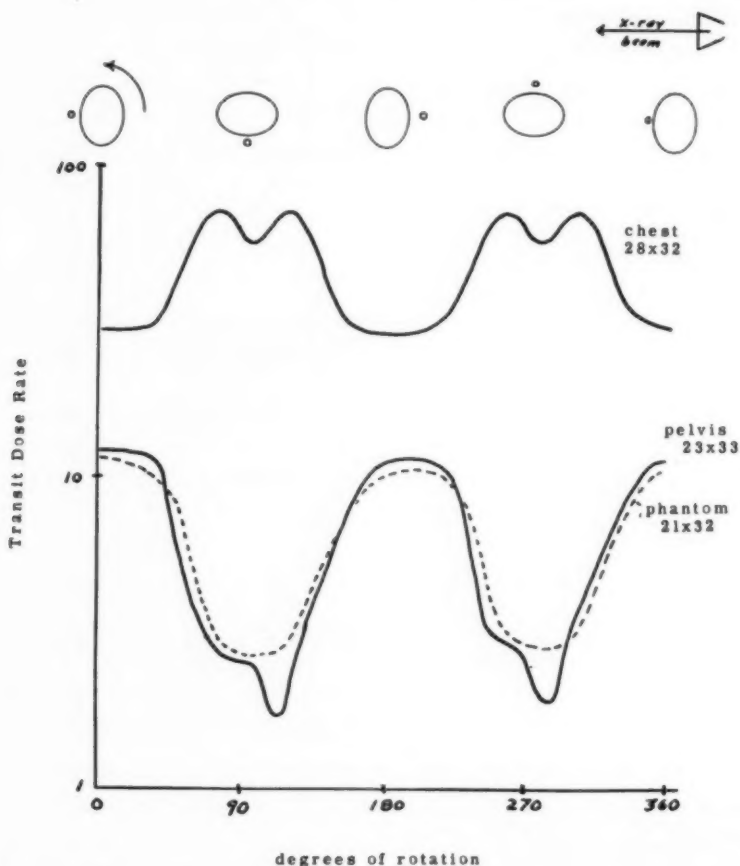


Fig. 6. Change of instantaneous dose rate with change in thickness and/or density of part, during rotation.

ionization chamber or a scintillation detector with suitable electronic discrimination against the scattered radiation.

OTHER APPLICATIONS

Rotation-dose rate studies have been made on patients and on phantoms, using the rate-meter portion of the Radocon. These have been highly instructive.

Figure 6 illustrates such a study, show-

ing that the thickness is increasing, showing that the average density is less than that of water in this section. In the pelvis and phantom, however, the transmission falls in these positions, as is expected from the increasing thickness of the part, because the average density is equal to that of water. A sharp drop in the pelvis curve in the lateral position is attributed to the femurs. The drop in the apex of the

thorax curve is attributed to mediastinal structures, and was not found uniformly in other patients.

Figure 7 compares tracings from three different chests. The marked variation in transmitted intensities from patient to

is that it gives information about dose at one point only. For information about off-axis points and the dose distribution study so necessary to decide what form of therapy is best adapted to the problem, point-by-point plotting of dose by the

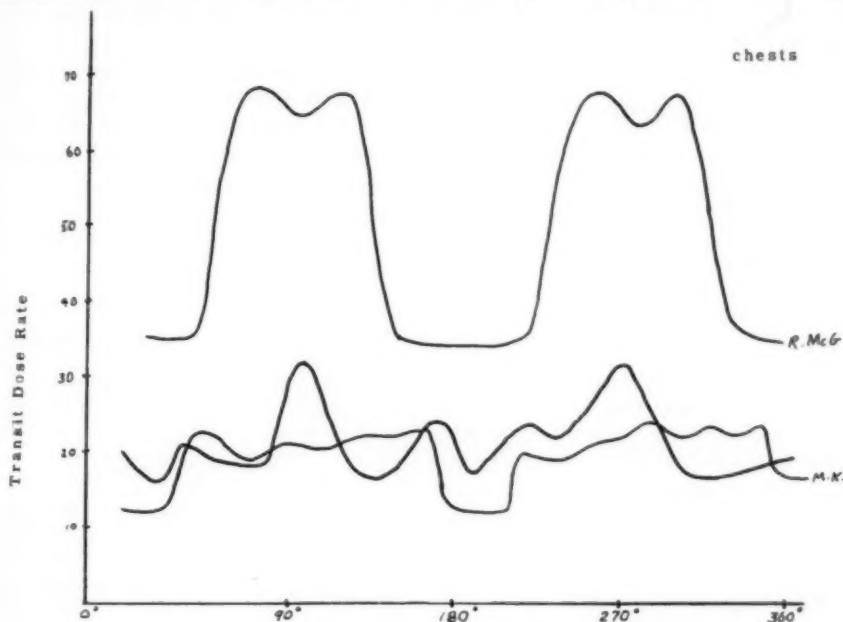


Fig. 7. See legend for Fig. 6.

patient is in agreement with studies by Nahon and Naidorf (7).

The rotation-dose rate curves, if they were made at the time of each treatment by the rate-reading device, could be used as a method of repositioning the patient during treatment, since the 90° and 180° points would be shifted to the right or left of the previous position. This shows promise of usefulness in areas of the body where sufficient contrast for fluoroscopic control is lacking, as the pelvis, and will be explored further.

Other advantages of the transit method are that it permits the recognition of day-to-day variations in tumor dose, shows changes in x-ray tube output, and is affected by changes in patient positioning, so that the transit chamber acts as a monitor over many factors in rotation therapy.

The major disadvantage of the method

sector method (3) is still necessary. There is some hope that the transit measurement may be used to obtain information about a specific array of off-axis points, but this has not been done yet. If the transit detector is displaced laterally from the ray through the axis, it will give dosage information for the points on a circle around the axis. Here, however, the true isodose curve will be an ellipse which intersects this circle; it is postulated that, at the point of intersection of this circle and ellipse, the transit dose will give true off-axis doses. A family of such points, lying on two intersecting lines, should be obtainable.

Another projected area of use of the transit method lies in its application to horizontal rotation therapy, where the dosimetry problems are greater than in vertical axial rotation therapy.

Our transit-dose method is intended for

use in the conventional voltage range, and has been investigated only at a half-value layer of 1.7 mm. Cu. However, a similar method could be set up for other qualities.

The system was transported to another institution, where measurements showed that the curves were reproducible for the same quality radiation in this different physical set-up.

CONCLUSIONS

1. The method of obtaining rotation therapy tumor dose information from the radiation transmitted through the patient during treatment has been confirmed. Phantom axis doses calculated by the sector method of Kligerman, Rosen and Quimby agree with the doses given by the transit chart.

2. The dose so obtained in patients differs from that calculated on the assumption of unit density tissue throughout, and in the manner expected, being higher in the lung-filled thorax and lower when major bony structures are present, as in the skull and pelvis.

3. The system offers the advantages of daily monitoring of treatment.

4. The disadvantage of the system is that it affords only axis dose information at present.

5. Theoretical equations have been written for the transit dose, tumor dose, and for the axis eccentricity correction factor. These equations give results which are in satisfactory agreement with the

experimental values for all but the largest phantom, area, and eccentricity, indicating that our instrumentation has not yet met the condition imposed by the equations. When this condition has been met, experimental verification will not be a prerequisite to use of the curves in other institutions.

6. The possibilities of using transit information for re-positioning, for off-axis dose information, and for horizontal beam rotation dosimetry have been discussed.

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SUMARIO

El Cálculo de las Dosis Tumor en la Rototerapia a 250 kv por Medio de la Velocidad de la Dosis Transmitida

Se ha sugerido (Wachsmann) que, en la terapéutica rotatoria, puede usarse la medición de la velocidad de la dosis de la irradiación transmitida para medir la dosis tejido en el eje de rotación. Trataron los AA. de confirmar la validez de ese sistema para la radiación de 250 kv., llevándolos sus estudios a las siguientes conclusiones:

1. Confirmóse el valor del método de

obtener información acerca de la dosis tumor en la terapéutica rotatoria por medio de la irradiación transmitida a través del enfermo durante el tratamiento. Las dosis en el eje fantasma, calculada por el método de sectores de Kligerman, Quimby y Rosen convienen con las arrojadas por la gráfica de tránsito.

2. La dosis así obtenida en los enfermos

discrepa, en la forma esperada, de la calculada presuponiendo que es uniforme la densidad de todos los tejidos, siendo más alta en el tórax lleno de pulmones y más baja cuando hay grandes estructuras óseas, como en el cráneo y la pelvis.

3. El sistema posee la ventaja de la recomprobación diaria del tratamiento.

4. La desventaja del sistema consiste en que actualmente sólo ofrece información sobre la dosis en el eje.

5. Se han elaborado ecuaciones teóricas para la dosis en tránsito, la dosis tumor y para el factor de corrección de excentricidad del eje. Esas ecuaciones suministran re-

sultados que convienen satisfactoriamente con las cifras experimentales para todas las zonas y excentricidades fantasmas, exceptuando las máximas, lo cual indica que la instrumentación usada no ha cumplido todavía la condición impuesta por las ecuaciones. Una vez cumplida esa condición, la comprobación experimental dejará de ser un requisito previo para el uso de las curvas en otros establecimientos.

6. Se discuten las posibilidades de usar la información obtenida en tránsito para el cambio de posición, para información relativa a la dosis fuera del eje y para la dosimetría rotatoria con el haz horizontal.

DISCUSSION

Carl B. Braestrup (New York City): One of the well recognized limitations of isodose data is that they are made on the basis of measurements in a phantom, which may or may not duplicate the distribution in the patient. The ingenious, yet simple, method described by Dr. Robbins and Miss Meszaros takes into account the actual attenuation of the radiation in the individual patient.

This scheme, therefore, is an important step toward more accurate dose determination, and it is particularly valuable in the conventional voltage range, where there is a very big difference between the absorption in bone and soft tissue. In teletherapy and supervoltage irradiation, the difference in absorption is much less, and conventional isodose data probably can be used in most clinical problems without any correction.

However, even with high-energy radiation this method offers a valuable means of positioning the patient in rotation therapy. The graph of the instantaneous dose rate during rotation shows clearly the alignment of the patient. In fact, this transit dose graph may prove more useful than the radiograph or the fluoroscopic image.

I believe that Dr. Robbins and Miss Meszaros have successfully devised an improved method of utilizing the transit dose in center dose determinations. Their system appears to be simple, yet equally accurate as that proposed by Wachsmann in his recent book on rotation therapy.

Richard H. Chamberlain, M.D. (Philadelphia, Penna.): I would like to ask Dr. Robbins a question: Does the method of transit dose measurement interfere in any way with the simultaneous use of fluoroscopy in the conventional voltage range and, if it does, which one he would rather do without.

Dr. Robbins (closing): When we use fluoroscopy in localizing our esophageal carcinomas, we use the first minute of treatment for the localization and then continue with the transit dose after that. If I had to choose one or the other, where I can localize the tumor by fluoroscopy, as in the esophagus, I certainly would choose to use the fluoroscope, but in all other locations we have nothing visual to help us in our daily localization.



Radiogold Seeds in Clinical Radiation Therapy¹

ULRICH K. HENSCHKE, M.D., Ph.D., ARTHUR G. JAMES, M.D., and WILLIAM G. MYERS,² Ph.D., M.D.

DURING THE first year of application of seeds containing radioactive gold 198 (1-7) in clinical radiation therapy at the Ohio State University Medical Center, 100 patients were treated with the new types of gamma-ray sources. Although insufficient time has elapsed for a definitive evaluation of clinical results, it is felt that enough experience has been accumulated to warrant a review of the place of radiogold seeds in the practice of radiation therapy.

No appreciable differences have been noted clinically in the reactions to therapy with radiogold, radiocobalt, radium, and radon. Radiogold seeds were found to be convenient replacements for the radon seeds formerly employed at this center. The simplicity of protection and the ease and speed of preparation of radiogold seeds of uniform strength were valuable in many situations.

Whether radiogold seeds should be used in preference to needles or nylon applicators containing radiocobalt or radium will depend largely on the clinical situation. For example, in tumors of the bladder or the gastrointestinal tract, the permanent implantation of radiogold seeds will often be preferable to the use of needles that must subsequently be removed because of the long-lived gamma-ray emitters they contain. Important uses for radiogold seeds will also be found where a large number of patients have to be treated on an out-patient basis because of the paucity of hospital beds.

Four methods of application of radiogold sources were used: (1) molds; (2) intracavitary applicators; (3) permanent

implants; (4) removable nylon implants.

RADIOGOLD SEEDS IN MOLDS

Molds with radiogold seeds were employed in 2 of the first 100 patients. One patient had a carcinoma of the skin and the other had a carcinoma of the floor of the mouth.

The long-lived radioisotopes, such as radiocobalt and radium, are the usual choice for molds, because no extra expense or labor is required in preparing these radioactive substances if they are available in the hospital. However, molds containing radiogold sometimes offer advantages over other gamma-ray emitters: (a) the necessity of hospitalization or repeated visits is obviated; (b) adjacent radiosensitive tissues can be protected effectively with lead shields; (c) recovery of the radioactive substances from the molds is not required.

(a) *Use of radiogold seeds in molds to avoid hospitalization or repeated visits* is occasionally valuable in elderly patients with small skin carcinomas who live far from the hospital. This method of treatment requires but a single visit to the radiotherapeutic center for the preparation and application of the mold. Subsequent removal of the mold and follow-up can be carried out by the physician who refers the patient.

For this type of application, radiogold seeds offer no essential advantages over radon seeds used in a similar manner. Occasionally, the immediate availability of the radiogold seeds may save a patient an extra trip, which may be required if radon seeds have to be ordered. The risk of

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² Julius F. Stone Research Professor of Medical Biophysics.

accidental loss makes the use of long-lived radioisotopes, such as radiocobalt or radium, undesirable for this purpose.

(b) *Effective protection of adjacent tissues by a lead shield* is a second reason for the occasional use of radiogold seeds in molds. The incorporation of lead in molds loaded with radiocobalt, radium, or radon seeds is not very effective, because the first half-value layer in lead is approximately 7.9 mm. for radium and radon filtered with 0.5 mm. platinum or gold and approximately 10.4 mm. for radiocobalt. In contrast, the half-value layer in lead for the gamma radiation from radiogold is only 2.7 mm. A lead shield of this thickness can usually be easily incorporated in the mold.

(c) *Elimination of the necessity of recovering the radioactive substances from the mold after treatment* is a third reason for the preference for radiogold seeds in some cases. Radiogold molds are simply discarded after use, while considerable labor and exposure to radiation may be involved in recovery of long-lived radioactive materials from molds.

In only one of the first 100 patients was there an opportunity to utilize all the advantages listed above:

CASE I: The patient was a white sales clerk, 50 years old, who had noticed an irregularity on the floor of his mouth for three months. On clinical examination, an indurated area 1.5 cm. in diameter, with superficial ulceration, was found. Biopsy showed a Grade II squamous-cell carcinoma. The tumor was treated by a permanent implantation of radiogold seeds inserted through the submental skin and an intraoral mold loaded with radiogold wires. The patient had only six front teeth in his lower jaw, to which his dental prosthesis was attached. In order to protect the tooth sockets, a lead shield was incorporated in the mold, which was made from dental compound (Fig. 1). The very reliable patient, who lived sixty miles from Columbus, was treated without hospitalization or repeated visits. He took the mold home in a lead container and applied it himself according to instructions. After one week, he brought back the mold, which was then discarded. A moderate mucositis developed, and the carcinoma disappeared clinically within three weeks. At the most recent follow-up, one year after the treatment, no evidence of disease was found and no sign of radiation damage was present.

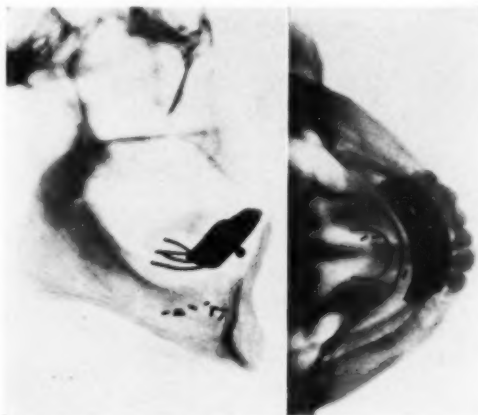


Fig. 1. Case I. Intraoral mold with radiogold wires and built-in protective lead shield combined with a permanent implant for treatment of a squamous-cell carcinoma of the floor of the mouth.

RADIOGOLD SEEDS IN INTRACAVITARY APPLICATORS

Intracavitary applicators were used in 9 of the first 100 patients. Three applications were made for carcinoma of the endometrium, and 2 each for carcinoma of the esophagus, the urinary bladder, and the urethra.

Radiocobalt or radium is the usual choice for intracavitary applicators. Here also, however, radiogold may occasionally offer advantages over other gamma-ray emitters: (a) Hospitalization of the patient or regular visits are not necessary; (b) smaller tubes can be used than with radium; (c) adjacent radiosensitive tissues can be protected effectively by a lead shield.

(a) *Use of radiogold seeds in intracavitary applicators to avoid hospitalization or repeated visits* is feasible only rarely, since most patients in whom intracavitary applicators are used require hospitalization. In the 100 cases upon which this paper is based advantage of this possibility was taken only once.

CASE II: The patient, an easy-going colored musician, 49 years old, was first seen in December 1952, with a large painful mass in the right lower jaw and difficulty in swallowing. Biopsies revealed a Grade III squamous-cell carcinoma of the esophagus with metastasis to the right mandible.



Fig. 2. Case II. Intracavitary applicator with radiogold seeds in nylon tubing used for treatment of esophageal carcinoma, without hospitalization.

A feeding tube was inserted, and high-voltage roentgen therapy was begun. The patient failed to keep regular appointments, however, and it was decided to attempt palliation by insertion into the feeding tube of a nylon tube loaded with radioactive gold seeds over a segment 15 cm. long. This was done Dec. 8, 1952, and a second application was possible on Dec. 19 (Fig. 2). The two applications delivered approximately 5,000 r on the surface of a cylinder 2 cm. in diameter. In addition, the metastasis in the right mandible was implanted permanently with radiogold seeds. The patient also received a tumor dose of approximately 3,000 r to the esophagus and 4,000 r to the mass in the mandible by external high-voltage x-ray therapy at his irregular visits. These treatments reduced the size of the mandibular mass to about 10 per cent and relieved the difficulty in swallowing nearly completely. The patient felt happy because, as he stated, he could "eat hamburgers again." He died from general metastases, at his home, seven months after the radiogold treatment, without having experienced any further difficulty in swallowing.

(b) *Use of smaller tubes than is possible with radium* is a second reason for the occasional use of radiogold seeds in intracavitary applicators. Compared with radon, there is no difference, since the outside diameter of both radiogold seeds and radon seeds is 0.8 mm. Radiocobalt pieces similarly used are even better in this respect, having a diameter of only 0.5 mm. However, radiogold or radon seeds incorporated in a tube of about 2 mm. outside diameter were small enough to be introduced even into such narrow passages as the urethra constricted by massive tumor involvement. The following case is presented as an example of the use of small diameter tubes in intracavitary applicators.

CASE III: A housewife, 65 years old, gave a history of vaginal bleeding for two months. Pelvic examination revealed a large uterus with the fundus about two and a half times the normal size. A Grade IV carcinoma was found by diagnostic curettage of the uterus. The patient was first treated with external x-ray therapy, receiving 2,000 r tumor dose from two fields. This was followed, on Oct. 15, 1952, by packing the uterine cavity with polyethylene tubing containing 44 radiogold seeds, each 4 mm. in length. Polyethylene tubing is preferred to nylon tubing for this type of application, because it is much more flexible. Since the outside diameter of the polyethylene tubing is only 2 mm., no dilatation of the cervical canal was required. The radiographs in two planes in Figure 3 show the packing in the uterine cavity, with a few seeds purposely inserted in the tubing in the cervical canal. The tubing was easily removed a week later, without sedation. During this time, a dose of approximately 7,000 r was delivered to the peritoneal surface of the uterus. Six weeks after the treatment, a total hysterectomy with bilateral salpingo-oophorectomy was carried out. Careful examination of the surgical specimen by a pathologist revealed no evidence of malignant cells. The most recent check-up on this patient, approximately a year after the treatment, showed no evidence of recurrence or radiation reaction.

(c) *Effective protection of adjacent tissues by a lead shield* may be a third reason for preferring radiogold seeds over other gamma-ray emitters for intracavitary applicators. In our first 100 patients treated with radiogold seeds, advantage was not taken of this possibility, but vaginal ap-

plicators with radiogold seeds and lead protection for the rectum have been used more recently.

RADIOGOLD SEEDS IN PERMANENT IMPLANTS

Permanent implants were carried out in 51 patients. Twenty-five of these, nearly

manent implants has the practical advantage over radon that seeds of uniform strength can be prepared immediately, whenever the need arises. This possibility was particularly advantageous in 7 of our patients, when a non-resectable tumor was unexpectedly encountered at surgery. Usually, the cutter in these cases

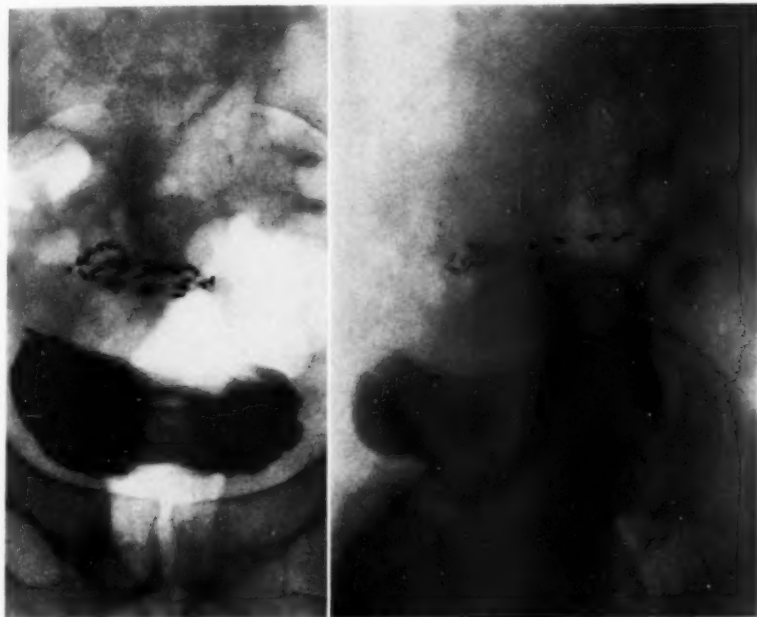


Fig. 3. Case III. Intracavitary applicator with radiogold seeds in polyethylene tubing used for treatment of carcinoma of the endometrium.

half of the total, had tumors of the head or neck. Most of the cancers were in advanced stages. Nine permanent implants were carried out in the urinary tract; of this number, 7 were in tumors in the bladder. Three tumors occurred in the vagina, 1 being primary and the other 2 metastatic from carcinoma of the cervix. Two hemangiomas in adults, 2 recurrences in the skin from carcinoma of the breast, 2 recurrent carcinomas of the colon, and 1 metastasis to the skin from bronchogenic carcinoma were also implanted permanently with radiogold seeds.

For permanent implants, only short-lived radioisotopes, such as radiogold or radon, can be used. Radiogold for per-

was brought to the operating room and the seeds were cut and calibrated within a few minutes. Advantage of the quicker preparation of radiogold seeds has also been taken in cases referred for consultation to the tumor conference, with immediate implantation following the recommendation of the conference. In this way, consultation and treatment can be carried out in a single visit, within a few hours, after which the patient is returned to the care of the referring physician.

With present implantation technic, the pattern of seed distribution in permanent implants is not as accurate as in removable needle or nylon applicator implants. For this reason, permanent implants are pre-

ferred over removable implants only if (a) removable implants are difficult to insert or (b) only short-term palliation can be expected.

(a) *Use of permanent implants when insertion of removable implants is difficult* finds its most frequent application in intra-abdominal tumors. It is especially in-

of multiple polyposis. A total colectomy and permanent ileostomy were carried out in June 1951 at this hospital. For a year and a half after the operation, the patient did well, but then started to lose ground. He was readmitted in May 1953, when physical and x-ray examination revealed a mass in the left lower quadrant. At operation, June 28, 1953, a firm mass, 8 cm. in diameter, was found in the mesentery of the small bowel. It

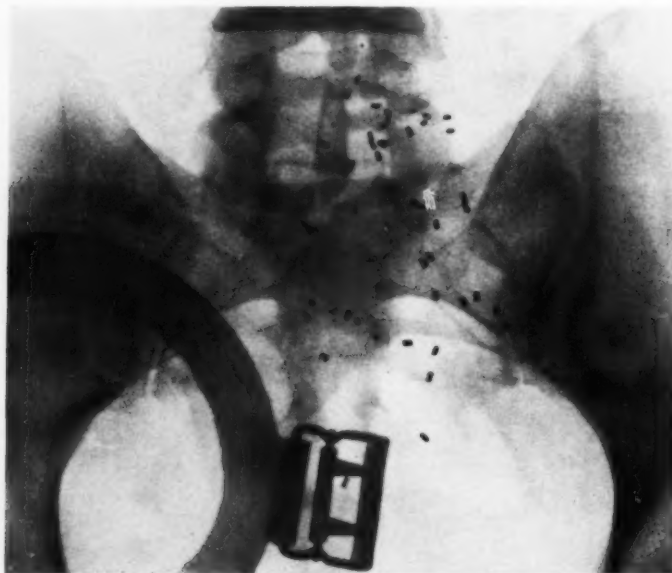


Fig. 4. Case IV. Permanent implant with radiogold seeds used for treatment of recurrence after resection of carcinoma of the colon.

indicated for tumors in the depth of the pelvis, as carcinomas of the bladder and of the prostate. Furthermore, for abdominal tumors a removable nylon implant cannot be prepared in advance accurately, since the shape and extent of the tumor are usually uncertain. Finally, in the abdomen, the withdrawal of needles or nylon applicators may cause bleeding. Fortunately, this complication was not encountered in the 5 intra-abdominal tumors in this series which were implanted with nylon applicators; but moderately severe hemorrhage was seen in the case of a tumor in the soft palate, and slight hemorrhage in a case of a hemangioma, during removal of the nylon applicators.

CASE IV: A 28-year-old white man had multiple adenocarcinoma of the colon on the basis

involved the region of the superior mesenteric vessels and therefore could not be excised. A separate tumor implant, 1.5 cm. in diameter, was present over the promontory of the sacrum, and an isolated node, 0.5 cm. in diameter, was found in the right side of the mesentery. Enteroenterostomy was carried out about the bowel more closely involved with the tumor, and implantation with gold seeds was requested. Radiogold seeds were prepared immediately, and fifty seeds were permanently implanted into the large mass, four seeds into the tumor implant over the promontory, and one seed into the small node in the right mesentery. In Figure 4 is shown the x-ray pattern of the seed distribution.

Following dismissal, the patient improved rapidly and gained 10 pounds in weight. He became free of pain and could again work full time in a steel plant. X-ray studies on a routine check-up, in November 1953, showed good regression of the mass in the area where the seeds were implanted. However, lateral to the original mass, a part of the tumor, which probably had not received enough

radiation from the implant, had increased in size. It was therefore decided to carry out a "third look" exploration and again to implant radiogold seeds

This case indicates that good palliation can be accomplished by implantation in non-resectable carcinomas of the intestinal tract, in which radiation therapy is frequently considered not worth while. It is

March 1953, when a right submaxillary node appeared. This was treated elsewhere with high-voltage external x-ray irradiation and a radon implant. Within two months the skin sloughed, exposing the right mandible. In July 1953 bilateral axillary masses appeared and were treated with x-rays in still another hospital. In September 1953, painful skin nodules developed in the right supraclavicular area and the patient was referred to this hospital.



Fig. 5. Case V. Permanent implant with radiogold seeds used for palliative treatment in ulcerated right supraclavicular metastases from carcinoma of the gum.

believed that permanent implantation might prove to be a valuable adjunct to the so-called "second-look" operations which have been suggested for more effective control of malignant tumors of the gastrointestinal tract.

(b) *Permanent implants when only palliation can be expected often appear preferable to a removable implant, since no preparation is required, local anesthesia is often sufficient, implantation is more quickly carried out, no supervision of the patient during the treatment period is required, and removal is not necessary.*

CASE V: A white electrician, 39 years old, had a Grade II squamous-cell carcinoma of the left lower gum in 1949, which was treated by excision and left mandibulectomy. He progressed satisfactorily until

Clinical examination showed far-advanced carcinoma with widespread involvement in the neck. Since the main complaint was the painful metastatic skin nodules in the right supraclavicular region, it was decided to attempt palliation by insertion of a permanent radiogold implant. This was done, and the patient returned immediately to his home, 120 miles from Columbus. A fair pattern in the implanted region is shown in Figure 5. A month later, the supraclavicular nodules had shrunk and there was complete relief of pain in this area. However, new subcutaneous metastases had developed in the occipital region and in the right chest wall. Implantation was carried out in these areas, and the patient returned home immediately. Because of the widespread involvement, it was expected that he would live only a few weeks. However, in a letter written eight weeks after the second implantation, he stated that "the lumps where you put the seeds in have gone away." He added that new "lumps" had appeared on the

other side of the neck and requested another appointment for treatment.

Although there has been considerable experience with implants of radon seeds here, it is difficult to evaluate a possible difference in therapeutic effect between radiogold seeds and radon seeds implanted permanently, since the variation in pattern is so great and the accuracy of implantation is the decisive factor. Appreciable differences have not been observed clinically.

RADIOGOLD SEEDS IN REMOVABLE NYLON IMPLANTS

Implantation with removable nylon applicators was carried out in 38 of the first 100 patients. Nineteen had tumors of the head and neck. Seven were referred for treatment of hemangiomas. Three had tumors primary in the bladder, and 3 recurrent carcinomas of the cervix. In 3 advanced breast tumors, implantation of the internal mammary chain was carried out by threading nylon applicators under the sternum. A recurrent carcinoma of the colon, a carcinoma of the skin, and a retinoblastoma, which occurred after x-ray therapy, were also treated.

Preparation of the nylon applicators requires time and skill. Furthermore, the technic of preparing these applicators to carry radiogold seeds is still in the developmental stage. It is possible to use nylon tubing in a manner similar to that developed for the use of small cylinders containing radiocobalt, by separating the gold seeds with aluminum spacers (8-10). However, since the gold seeds have almost twice the diameter of the radiocobalt cylinders, tubing with a larger internal diameter is necessary. This larger tubing lacks the flexibility of that used for radiocobalt. In order to overcome this difficulty, a flat, very flexible nylon "ribbon" is being developed in which the seeds are firmly held, without spacers. This ribbon is even more flexible than the nylon tube used for radiocobalt, but occasional breakage due to faulty preparation is still encountered.

Nylon implants are preferred here over needles for removable implants since they provide for (a) more accurate implantation, (b) better individualization of treatment, (c) more comfort to the patient, and (d) decreased exposure to the operating personnel.

(a) *More accurate implantation* is the first reason for our preference for the nylon technic. As pointed out above, with the present method of permanent implantation, the pattern is not very regular. Stiff needles loaded with radiocobalt or radium can be implanted accurately in parallel rows, but a good pattern is frequently difficult to achieve because of the necessity of "crossing of the ends." This limitation can easily be avoided in nylon applicators by loading the ends with more active sources.

(b) *Better individualization* is a second reason for preferring nylon applicators over needles. The nylon tubes are loaded individually for each patient. After use, they are discarded by putting them in a dump until the residual radioactivity subsides. The implantation is usually planned in such a way as to give the desired dose in seven days. During this time, 84 per cent of all the ionizing energy of the radiogold seeds is spent. Only rarely does the pattern deviate from the planned arrangement of sources. Adjustments are made by withdrawing applicators at different times. This is a worthwhile advantage compared with permanent implants, where no adjustment is possible after the implantation.

Various patterns of loading have been used. In most instances, either seeds of equal strength were distributed uniformly throughout the implant, or nylon applicators were loaded more heavily along the edges to give a more uniform dose throughout the treatment area, according to the principles laid down by Paterson and Parker.

(c) *Greater comfort to the patient* is a third reason for preferring nylon applicators over stiff needles. This is especially true for curved surfaces and in locations

where muscular movements normally occur frequently. A nylon implant also stays in place better than a needle implant. Fixation of the ends of the applicators with adhesive tape or clips is usually adequate, and it is not necessary that they be sutured in place.

(d) *Decreased exposure to operating personnel:* Since the ends of the nylon applicators are stretched into filaments several feet long, the loaded part can be shielded within a lead carrier, while the unloaded ends are sutured through the tumor. Following this, the radioactive parts of the applicators can be pulled into place in a few minutes. Because the total exposure to personnel is the product of time and dose-rate, keeping the time as short as possible usually reduces the total-body radiation received by the operator, as well as the dose to the hands, to less than the permissible dose.

Two cases may illustrate the accuracy of nylon implants, the individualization of the pattern, and the comfort of the patient during the time the implant is in place.

CASE VI: A white housewife, 42 years of age, gave a history of small multiple skin nodules appearing twenty-five years earlier and increasing slowly in number and size without causing any annoyance. After two years, medical advice was sought and a diagnosis of neurofibromatosis (von Recklinghausen) was made. Some six years later the patient noticed that a small lump in the right supraclavicular area kept enlarging, causing radiating pain. Fifteen years before she was seen in this hospital, a diagnosis of fibrosarcoma originating in a neurofibromatous nodule was made. External radiation therapy (dose and quality unknown) had been given intermittently at monthly intervals during the intervening years, and apparently checked the growth quite effectively.

In May 1953, the patient came to this hospital because the node had begun to grow rapidly and was causing severe pain. Surgical consultation was obtained, and opinion as to the resectability of the tumor was divided. The radiotherapy department was in favor of resection, but the surgical department decided against it. Since it appeared that, by proper selection of fields, the heavily irradiated skin area could be avoided, another course of x-ray irradiation was given, a tumor dose of 4,000 r being delivered from two opposing fields in an overall time of sixty days. This gave



Fig. 6. Case VI. Nylon implant with radiogold seeds used for treatment of a fibrosarcoma in right supraclavicular region. Uniform loading of the nylon applicators.

good relief of pain, and the tumor was reduced in size by about 50 per cent. Three months later, however, the patient returned with recurrence of pain. It was then decided to try an implant of radiogold seeds in nylon applicators. This was carried out under good sedation and right cervical block. A uniform distribution of the seeds was chosen (Fig. 6) in order to get a higher tumor dose in the center of the mass. The tumor dose in the implanted area was calculated to be 6,000 r on the basis of Quimby's tables. When the patient was last seen, the pain was considerably relieved and the mass had disappeared completely. However, above the original mass and outside the field of implantation, a new mass had developed which was pressing on the brachial plexus. Another implantation into this mass is scheduled.

CASE VII: An 80-year-old white woman had a Grade I squamous-cell carcinoma of the cheek, resected three times in two years: May 1951, August 1952, and July 1953. She now presented another recurrence in the same area. In view of her age, radical surgery was not advised, and an implantation of radiogold seeds in nylon tubing was carried out on Sept. 29, 1953. The pattern is shown in Figure 7, being curved in such a way as to have a slightly larger spacing in the middle. The seeds on the inside were only about half as strong as the outer ones, even though they were longer, because they were made from an earlier shipment of radiogold wire. Calculations in accordance with the Paterson-Parker tables gave a tumor dose of 6,000 r during the week the implants remained in place. The patient was dismissed from the hospital a day after the implantation was made.

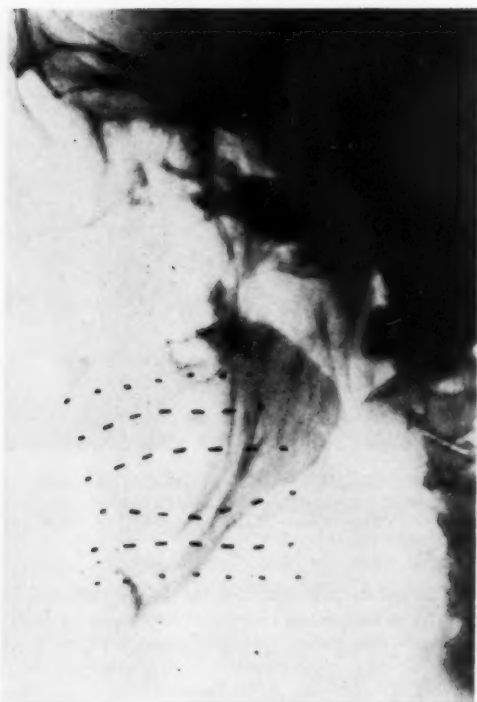


Fig. 7. Case VII. Nylon implant with radiogold seeds for treatment of a recurrent carcinoma of the cheek. Differential loading with longer but weaker seeds in the middle.

During the week of irradiation, this sensitive, frail old lady felt very comfortable and had no difficulties in eating or speaking. She returned for removal of the implant, which was easily carried out without sedation. A moderate mucositis developed, which cleared up in three weeks. When the patient was last seen, two months after the implantation, she presented no evidence of tumor or radiation reaction. This case also illustrates that patients with implants in nylon tubing can be treated without hospitalization.

Clinically, the same responses in tumors and normal tissues have been observed as were encountered previously with compar-

able implantations of radiocobalt in nylon tubing (8-10).

SUMMARY

Clinical experience in the first 100 patients treated at the Ohio State Medical Center with radiogold seeds has shown that these seeds can be used successfully as replacements for radon seeds. The simplicity of protection and the ease and rapidity of preparation of radiogold seeds of uniform strength are advantageous. No appreciable differences in therapeutic response were observed as compared with radon seeds.

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SUMARIO

Las Semillas de Radio-Oro en la Radioterapia Clínica

Las observaciones clínicas en los primeros 100 enfermos tratados con semillas de radio-oro en el Centro Médico del

Estado de Ohio han demostrado que pueden usarse con éxito esas semillas como substitutos de las de radón. Usáronse

cuatro métodos de aplicación: en moldes, en aplicadores intracavitarios, en implantes permanentes y en aplicadores extraíbles de nilón.

La fácil y rápida preparación de los im-

plantes de radio-oro y lo sencilla que es la protección resultan ventajosas. En lo que se ha observado, la respuesta terapéutica no discrepa de la obtenida con las semillas de radón.

DISCUSSION

Richard H. Chamberlain, M.D. (Philadelphia, Penna.): With the really tremendous number of radioactive isotopic materials available to us, we must apply the method of thinking that Dr. Henschke and Dr. Myers have used in searching for better methods of treatment with them. Otherwise we would be missing both an opportunity and an obligation.

Particularly it is my feeling that the search for better methods of using interstitial sources is likely to be one of the most rewarding efforts in the field of radioactive isotopes. Apart from the difficulties involved in injecting radioactive materials in liquid form, as colloids or soluble materials, the advantages of being able to place small particulate sources in certain areas would seem to be a first approach in trying to improve on our present methods. I do not think that there should be a competitive spirit in seeking to exclude radiocobalt, radium, or radon in favor of radiogold in particulate form, but rather that we should try to look at all of them to determine what each one might do better than the other in a specific clinical situation.

I was delighted to hear Dr. Henschke dwell on the biophysical advantages and disadvantages as a point of first consideration. Certainly this should be done first in any careful study. We have the means now to do it, and I am impressed with this point of view as the logical one.

Secondly, the ingenuity of the method of application of the material in the body is most interesting to those of us who are gadget-minded but also has a very definite bearing on what we can expect in the final clinical results.

Thirdly, we are faced with the determination of dosage. This cannot be overemphasized, and in the use of particulate sources which are radiographically opaque we have an unusual opportunity to study the pattern and to analyze the final result from the standpoint of the dosage administered.

We have been intrigued with the possibility, particularly in three-dimensional implants of the permanent type, of trying to apply the orthoradiographic reconstructions that have been used so beautifully for radium. The opportunities for reconstruction of dosage at all points are unlimited in this way. There is also a possible field for the employment of body-section roentgenography for reconstruction of these point sources.

Finally, we must not lose sight of the fact that the proof of all new methods will finally come in the clinical results. I think that, no matter how eager we all are to try these methods, we must realize that not only *some* experience but *long-term* experience will be needed to do the best job and is essential for final judgment as to the worth of the technic.



Radiation Hazards in the Practice of Radiology¹

CHARLES M. BARRETT, M.D.

DURING THE PAST eight years, the attention directed to radiation has been highlighted by a growing interest in the dangers resulting from over-exposure. Knowledge of the harmful biological effects of ionizing radiation is naturally of vital importance to the radiologist. It is his responsibility to recognize the inherent hazards and to take steps to minimize them, since they threaten the health of those engaged in the use of radiological technics for both diagnostic and therapeutic purposes.

That ionizing radiation could produce injury first came to the attention of the medical profession when workers in this field began to exhibit certain abnormalities which could not be attributed to other causes. The first instances of injury due to this cause were noted within the year following Roentgen's discovery of x-rays in 1895. It was observed, for example, that severe skin reactions and temporary or permanent baldness sometimes appeared after exposure (1). By the beginning of 1897 at least 23 instances of skin lesions caused by over-exposure to x-rays had been reported in the literature, and the effects of radiation on deeper tissues were coming to be recognized. In 1897 a British publication remarked: "It is of great importance that we should ascertain exactly what is the influence of these rays on both plants and animals for, no doubt, grave considerations of health are involved."

In the modern hospital, it is entirely possible to provide adequate protection to insure the safety of personnel occupied with one or another of the forms of radiation. Despite this fact, one cannot but be alarmed at the number of radiation injuries which are being reported in appar-

ently well equipped and well controlled radiological departments in this country. It is well known that all types of radiation produce essentially identical effects, that is, cell injury to a greater or less degree. Biologically speaking, x-rays, gamma rays, and alpha and beta particles differ from the most part only in the distribution and magnitude of the damage produced. Consideration of detrimental effects of x-rays or radioactive isotopes may be discussed in three general categories. These are concerned with the effects of (1) the maximum dose localized at any point of the body; (2) the total body dose; (3) the dose to the reproductive organs. There are several sources of danger in the use of ionizing radiation and these will be considered independently.

DIAGNOSTIC RADIOLOGY

Radiation injuries of the type formerly frequently encountered are of much less common occurrence today. Injury to local sites, such as ulcerations on the hand and fingers, has been greatly minimized because of the protective devices now widely utilized (3). On the other hand, the problem of injury to the hemopoietic system, while reduced, has not yet been overcome. The greatest single risk faced by the radiologist at the present time is that of leukemia. Henshaw (4) has indicated that leukemia occurs more frequently among physicians than among the general population, while March (5) has shown that its incidence among radiologists is ten times that among non-radiologic physicians. In this connection, an example of radiation injury studied by us may be cited.

In the course of a survey, a radiologist was found to be receiving total-body irradiation varying be-

¹ From the Departments of Surgery and Radiology, College of Medicine, University of Cincinnati and the Cincinnati General Hospital, Cincinnati, Ohio. Presented at the Thirty-ninth Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 13-18, 1953.

tween 0.2 and 0.5 r per day, depending upon his schedule, a rate of exposure obviously in excess of the reasonable limit of tolerance acceptable according to American safety standards (6). According to these standards, his fluoroscopic schedule should have been limited to approximately fifteen minutes each day. Estimates based on calculation of his daily work indicated that he had received 250 mr to 500 mr total-body irradiation each day over a period of twenty years. Shortly after these computations were made, a routine blood count revealed the presence of leukemic cells in the peripheral blood, due presumably to the radiation exposure. This is one of the few recorded cases of leukemia developing in a radiologist whose exposure had been surveyed prior to diagnosis.

Measurements of radiation in our survey were made with film badges, pocket meters, and beta-gamma portable counters calibrated according to standard technics. The above devices check relatively closely when subjected to known amounts of radiation. While there are certain defects in measurements of this nature, for practical purposes they are generally acceptable (7).

Hazards in fluoroscopy are due mainly to the radiation that reaches the patient's body and then scatters as secondary rays. This secondary radiation, in turn, strikes the body surfaces of the examiner, and the amount of radiation thus received is inversely proportional to the steps taken to insure protection. It is quite essential that the primary beam be directed in a straight line so that the fluoroscopic tube is centered upon the screen. If the tube is angled or tilted, the radiation striking the patient and scattering to unprotected areas of the operator may be excessive. For example, in one installation checked, the tube was rotated in such a fashion that the operator received much more scattered radiation to his upper face and forehead than the permissible daily allotment. As a general rule, the safest location for the examiner is directly in front of the fluoroscopic screen. Slight tilting of the tube, however, places the radiation above or below the screen and acceptable limits of exposure may be exceeded. The amount of radiation can be checked with little difficulty by means of the beta-gamma

survey meter or pocket Victoreen meter.

It is also important to know how much radiation leaves the x-ray tube and strikes the table top. Figures have been obtained indicating that the output at the table top should not exceed 20 r per minute. In one installation in which we found the amount of scattered radiation to be excessive, it was noted that the intensity of the primary beam at the table top was 55 r per minute. This excess radiation was accounted for when it was learned that the tube had been removed at some prior time for minor repairs and the filter had not been replaced. The amount of scattered radiation received by the operator, which exceeded greatly the usually accepted limits, was reduced on reinsertion of the filter. It is an established fact that an increase in filtration diminishes scattered radiation. Some radiologists increase the kilovoltage and add filter, retaining good fluoroscopic visibility with lessened radiation hazard. A filter of 3 mm. of aluminum with 85 kv. has been recommended for fluoroscopy.

Generally speaking, the operator receives more radiation when fluoroscopy is done with the table in the horizontal position than in the vertical. This is due to the fact that radiation is scattered through the aperture of the Bucky grid at the side of the table. This may expose unprotected portions of the body, such as the sides and buttocks, and constitute a serious radiation hazard.

The use of protective gloves and aprons no longer requires emphasis; yet even with these accessories hazard may exist. Faulty material and worn out aprons may not give the protection which the operator believes is present. For this reason, protective devices should be routinely checked for safety in all departments. Too often we learn of radiation injuries which have occurred in apparently well equipped departments. In a group of 15 hospitals which we surveyed, the more modern equipment was generally safer than old equipment, although much of the latter was still in use.

The recommendations made by those who have been interested in this problem are worthy of serious attention (8). These include the use of small portals for fluoroscopy and the proper pre-adaptation of the eyes so that lower milliamperage may be used. The need for protective devices such as fluoroscopic chairs, aprons, and screens is readily appreciated when surveys record 350 mr per hour in the spot where the operator works. It is common for some operators to sit down while examining the patient in the upright position. This is acceptable if the lower leg, thigh, and scrotum are adequately protected.

We feel that the radiologist should never expose himself unnecessarily to the smallest amount of avoidable radiation since the effect may be cumulative. Many radiologists are guilty of needless exposure when passing by a diagnostic apparatus during the process of film taking. While the individual exposure in this instance may be small, the aggregate of repeated minor exposures may be significant.

RADIUM

The use of radium offers a possibility of danger in several ways. Protracted handling may be a source of over-exposure, as in loading applicators or during actual implantation into the body. If accidentally released from its capsule, radium becomes particularly dangerous, since it may be ingested, inhaled, or otherwise absorbed by the body. Under these circumstances the long-lived alpha emitting isotopes represent a particular threat. The amount of body retention naturally depends upon the type of radium used. Radium sulfate is usually less readily absorbed than radium chloride or radium bromide. After inhalation or ingestion, however, the greatest absorption occurs when the chloride has been used. With adequate precautions in the preparation of the applicator the amount of radiation received by the operator is greatly reduced. It is recognized that none of these procedures incident to radium therapy can be performed without subjecting the operator to some exposure.

It is important, however, for each operator to review his technic and to ascertain exactly how much radiation he is receiving in the various positions he assumes, so that changes of procedure may be made to reduce exposure.

Preparation of Radium Implant: One of the commonest dangers encountered in the use of radium is in its preparation for treatment of carcinoma of the cervix. For this type of implantation 60 or 70 mg. of radium are used and the dosage is divided between the vaginal and uterine applicators. The following measurements were recorded during the loading of such an applicator when suitable protection was used: right upper arm, 5 mr; right wrist, 20 mr; left arm, 30 mr; left wrist, 10 mr; chest 0. Adequate lead shielding and a minimum handling time are required to keep exposure at or below these levels. With faulty technic, exposure will often be much greater.

Similar preparation without the benefit of lead shielding, as is customary at the operating table, results in considerably greater dosage received by the operator. We have recorded the following measurements at the operating table in the absence of protective shielding: total-body irradiation, 150 mr per hour; right arm, 400 mr per hour; left hand, 450 mr per hour; left wrist, 400 mr per hour; right wrist, 500 mr per hour.

During insertion of the radium into the uterus and vagina, the following measurements have been recorded: right arm, 400 mr per hour; left hand, 450 mr per hour; left hand while packing the vagina, 450 mr per hour; total-body irradiation, 40 mr per hour; fingers of the right hand, 600 mr per hour. In an average case of carcinoma of the cervix, with the above technic we believe the operator receives the following amount of radiation when he performs both the loading and the insertion of the applicator: total body, 35 mr; right hand, 150 mr; right arm, 80 mr; fingers of the right hand, 200 mr; fingers of the left hand, 150 mr; left arm, 75 mr.

The use of interstitial radium needles

also presents a radiation hazard. During the application of radium needles in a typical case of carcinoma of the tongue in which 20 mg. of radium are used, the operator has been observed to receive a total-body irradiation of 120 mr; left hand, 185 mr; right hand, 130 mr. This amount of exposure exceeds more than twice the daily amount permissible for the total body. We believe, therefore, that the total body radiation received by an operator during this type of procedure is of such order that he be permitted no further exposure during that day. We feel, also, that it is important that the person who has applied radium interstitially should not be subjected to additional exposure from diagnostic procedures or isotopes.

Contamination by Radium Particles: One hazard not commonly appreciated is the danger attendant upon breakage of radium capsules with the possibility of inhalation or ingestion of radium particles. This risk is particularly likely to be overlooked by persons who use radium only occasionally and who are unaware of the potential dangers inherent in faulty radium capsules. There are two types of radium tube, the American type and the European capsule-filled or cell type (9). The latter is permanently sealed in some instances and demountable in others. It is in the demountable type that the hazard of radium escape is more prevalent. In recent years, instances of radium contamination have been reported in the radiologic literature. In addition to the reported cases, it is believed that many accidents occur which do not reach publication. To prevent breakage or escape of material from radium capsules, the containers should be examined once a year by persons especially trained for this purpose. A careful survey by microscopy reveals points of leakage which are often not apparent to the naked eye. Even simpler methods may be employed in routine fashion to determine whether or not radium salt is escaping from the applicator. One method consists in the use of filter paper "swipes" of the radium capsule for measurement by

counting chambers. If the radium capsule is sealed in a filter paper disk in a small test tube for a period of from one to three days, the alpha particles can be detected when the filter paper is placed before a counter (10). Cotton "swipes" of the radium capsule may also be of great help.

Heat may cause explosion of radium capsules. For this reason, cold sterilization rather than boiling is preferred. If a radium capsule explodes, radium salt is disseminated over a large area, and tracking of the salt by various individuals may lead to widespread dispersal. This complicates the problem of decontamination and magnifies the hazard of radium inhalation or ingestion. Radium salt can be absorbed from the lung or gastrointestinal tract and deposited in bone. The resulting bone marrow injury may ultimately result in the development of a malignant tumor. It may be possible to avert such an eventuality if the radium containers are examined as a routine measure and extreme care taken in their handling. We have had the opportunity of observing one serious accident in which the lives of a number of individuals were placed in jeopardy due to wide dissemination of radium salt.

Should radium capsules break or leak, it is essential that a survey be made of the room and that the areas of contamination be clearly designated. Air samples should be obtained in order to determine the amount of radioactive material present. Strict traffic control should be maintained until the area is decontaminated. If electric fans or other circulating devices have been used, the air may contain radium particles. When such contamination exceeds the current permissible concentration of 8×10^{-12} mc./ml. it may become necessary to use respirators. This concentration is difficult to detect without special air sampling and counting equipment. Whenever possible, it is important to remove the damaged radioactive source and under such circumstances special protective clothing and respirators must be

worn. The entire area of contamination is then covered with plastic strips. After these strips have been dried for twenty-four hours, they can easily be pulled up and placed in sealed drums for disposal. Certain strip paints can be used to coat the floor where contamination has occurred. Thereafter, the strip paint is removed and most of the radioactive material with it. It is sometimes necessary to employ vigorous methods of decontamination. Surfaces may be removed by sand blasting, scraping, or burning. Commercial solvents mixed with water are often effective for similar purposes.

There are certain measures which should be employed for the protection of individuals accidentally exposed to radium emanation. All suspects should be surveyed for alpha and beta contamination. Exposed persons should remove all clothing, which then is placed in a container. Shower baths should be taken, and soap and detergents utilized vigorously. Special attention should be given to cleaning nails, toes, scalp, ears, and body folds. Following washing, individuals should be surveyed with a suitable monitoring instrument. The portable alpha meter of the scintillation type is preferable for this purpose. Gastric lavage with 10 per cent magnesium sulfate should be done as soon after exposure as possible. Daily purging with saline cathartics will promote excretion of radium from the gastrointestinal tract, and the cathartic also acts as a cholagogue. These measures are important since radium is excreted to a large extent through the gastrointestinal tract.

Certain other protective measures are desirable for seventy-two hours following radium contamination. These include measurement of radioactivity of urine, blood, and feces.

ROENTGEN THERAPY

Roentgen therapy is usually the safest branch of radiology in respect to radiation hazard to the operator. The only significant danger results from the improper

shielding of working areas. Lead barriers may have been removed unwittingly, or the required protective shielding material may have been miscalculated. These defects are easily checked by the use of meters employed in detection of scattered radiation. Special attention should be given to doors, hinges, and lead glass windows. If the valve tubes are in another room from the therapy operation, measurements of possibly scattered radiation from that source should be conducted.

ISOTOPES

The danger attendant upon work with any of the radioactive isotopes depends entirely upon its half-life. The longer the half-life, the greater the hazard. This problem has been well reviewed, and responsible persons handling radioactive isotopes are cognizant of the problem of preventing radiation damage and contamination. A recent survey in the Isotope Laboratory at the Cincinnati General Hospital revealed the fact that the risk associated with the use of short-lived isotopes was much less than that associated with routine fluoroscopy or with radium.

COMMENT

The existence of radiation hazards does not, of course, constitute an insurmountable barrier. It is, however, of the utmost importance that the existing dangers be recognized and that the underlying physical principles be understood in order that the danger may be minimized. There have been numerous reports of severe radiation damage and those of us who work in the field of radiology should carefully analyze the hazard and intelligently construct methods which will remove the peril from our daily work. It is particularly important that the individual engaged in the practice of radiology outside of a large medical center constantly review his technic and take the necessary steps to prevent injury to himself and his co-workers.

NOTE: The author expresses appreciation to Dr. Eli Rubenstein of the Department of Radiology for his assistance in computing the data presented.

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SUMARIO

Riesgos Creados por la Irradiación en el Ejercicio de la Radiología

Considéranse aquí los peligros que corren el radiólogo y sus compañeros en relación con la radiología de diagnóstico y la curie y roentgenoterapia.

En la roentgenoscopia, los riesgos proceden principalmente de la irradiación esparcida del cuerpo del enfermo y de la porción superior de la mesa. Las precauciones que hay que tomar comprenden cuidadoso encaminamiento del haz primario de manera que el tubo roentgenoscópico se centre en la pantalla; filtración adecuada; comprobación sistemática del equipo protector, p. ej., guantes y delantales; uso de puertas pequeñas; y adaptación apropiada de los ojos de modo que pueda usarse un miliamperaje bajo.

Los peligros relacionados con el radio

comprenden: (1) hiperexposición a consecuencia de manipulación prolongada al cargar los aplicadores e introducir implantes de radio y (2) contaminación incidental a la rotura de cápsulas de radio. Las precauciones comprenden resguardos adecuados de plomo y tiempo mínimo de manipulación en la preparación de aplicadores; evitar la exposición procedente de otros focos por los operadores que ejecutan procedimientos de implantación; medidas apropiadas de descontaminación en caso de rotura de cápsulas de radio o de escape de recipientes de radio.

En la roentgenoterapia, el único peligro importante para el operador proviene de la defectuosa protección de las zonas de trabajo.

DISCUSSION

Richard H. Chamberlain, M.D. (Philadelphia, Penna.): At first glance, one might think that the fine paper which Dr. Barrett has given us would be unnecessary to so sophisticated an audience as this. That this presentation is particularly appropriate is due to the fact that our own practice with respect to radiation hazards is not all that it should be and that our own house is not completely in order.

The radiation hazards which have been discussed are intensely practical. They are not confined to major institutions and to ivory tower centers of re-

search. Protective measures against them should be part of the thinking and practice of every radiologist.

There is no excuse for slipshod practices in radiation protection as it applies to diagnostic apparatus, radium and x-ray therapy, and radioactive isotopes in this day and age. With radioactive isotopes, one is constantly reminded of the possibilities of contamination with radioactive material as well as the external radiation hazards, but, as Dr. Barrett has pointed out, this same possibility also exists with radium, and many of us have been surprised to find

how much contamination is present in unsuspected areas from work that has been going on for many years. This contamination has often been discovered only by the use of new instruments acquired for measuring the various radioactive isotopes.

The very sensitive instruments which are currently available can show us not only the presence of contamination but also the fields of external radiation intensity about all of the materials and equipment that we use. These instruments are not prohibitively expensive and should be part of the equipment of even moderately sized radiology departments and private offices.

Even more important, perhaps, is the point of view of the radiologist as he works with radiation-producing agents. He must develop a sense of the relative exposure hazard as he moves about in his daily work. In almost every instance, it is possible to prevent unnecessary or excessive exposure and, if the amount of radiation is found to be excessive by the use of proper instruments, his interest should be stirred to take measures to keep it at a minimum.

The obligations for safety are not confined to the radiologist but include consideration of patients and innocent bystanders. Another obligation is to set a good example to other medical users of radiation-producing equipment and to our students.

The Handbooks of the National Committee on Radiation Protection have outlined almost everything that one needs to know about radiation protection and the safe levels of practice. Additional information is available in the *Planning Guide for Radiological Installations* which has recently been published by the American College of Radiology.

It is only by being certain that our own practices in radiation protection are the best obtainable, and by trying to encourage an equally high standard among other medical and non-medical users of radiation, that we will be able to keep ourselves free from the moves for restrictive legislation on radiation protection which are currently being proposed in many parts of the country.

George C. Henny, M.D. (Philadelphia, Penna.): I was interested to notice that Dr. Barrett spent the least time on x-ray therapy, the field in which the most penetrating radiation is used. I think he was wise in doing this, because radiologists are aware of the dangers involved and thus erect

protective barriers, make protection measurements, and avoid exposing themselves. But it makes me think of a sometimes neglected danger which may, to the unwary, seem to be a paradox. It is the rather natural instinctive feeling that because a machine is small and is operating at relatively low kilovoltage it is safe, especially when compared with a therapy machine. With the small x-ray machine, such as a shock-proof head fluoroscope, the operator may be very close to the tube and to the patient and he may at the same time neglect to take proper protective precautions. Thus, the smaller the x-ray machine, the more dangerous its use may be.

John S. Bouslog, M.D. (Denver, Colo.): I am thinking about the portable machines in the operating room. I would like to hear their use discussed.

Dr. Barrett (closing): In answer to Dr. Henny, the safety devices are quite suitable. We have made measurements and found that the protection was very satisfactory. Of course, that is protection solely from scattered radiation, not from the direct beam.

As far as the portable machine in the operating room is concerned, the greatest hazard is direct radiation, and that certainly should be avoided. The surgeon or orthopedist working in the operating room can remove himself from the scope of the primary beam. The amount of radiation observed by us during examinations in the operating room was surprisingly small. These measurements were limited to scattered radiation and the common figure ranged between 50 and 75 milliroentgens.

It was also interesting to note that during angiocardiology the surgeon received relatively little exposure from scattered radiation. As a matter of fact, we had anticipated a far greater figure than that which we finally determined to be an average. We found that the surgeon received, as a general rule, no more than 50 milliroentgens total-body radiation during one procedure.

One other point I think may be worthy of mention, and that concerns itself with the manipulation of the hand fluoroscope. The orthopedic surgeon uses this device frequently and his risk may be serious. We, as well as many others, have seen permanent damage result from prolonged fluoroscopy during the reduction of fractures.



Tomographic Aspect of Paralysis of the Vocal Cords¹

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TOMOGRAPHIC study of laryngeal paralysis has received little mention in the literature. Many articles have been written describing tomographic exploration of the physiology of the larynx during phonation (1-4, 6, 8, 9-13), but only Canuyt, Gunsett and Greiner (5) have dealt with the tomographic appearance of the paralyzed larynx. While it is true that paralysis of the vocal cords can be diagnosed easily by mirror examination, its tomographic description is of interest for several reasons. In the first place, there are many patients on whom indirect laryngoscopy is impossible for one reason or another, and in these instances tomograms may settle the diagnosis; secondly, the study of the paralyzed larynx gives a better understanding of its limited mobility in the presence of local disease.

The recurrent laryngeal nerve innervates all the muscles of the larynx except the cricothyroid, which receives its nerve supply from the superior laryngeal nerve (7). Any pathological process involving the recurrent laryngeal nerve in its course will produce paralysis. In the series of cases upon which the present paper is based, malignant tumors in the thorax or in the neck have been the main etiologic factors. A few cases of laryngeal paralysis secondary to thyroidectomy have been seen, allowing a study of the changes which take place in long standing denervation. In all cases lateral films of the neck were obtained before tomography. The only reliable sign found in this position is a slight anterior displacement of the paralyzed arytenoid cartilage; this is evident, however, only when the cartilage has un-

dergone some calcification. Changes in size and shape of the ventricle in the lateral films which have been emphasized in the literature are neither constant nor sufficient for diagnosis. Visualization of the ventricle is almost always better when there is paralysis of one of the vocal cords. The flaccid cord produces the changes in appearance, mainly when the films are made during phonation or with the Valsalva maneuver. There is no intention of denying the value of lateral films for differential diagnosis, as they are invaluable for that purpose and should be taken routinely before tomograms are made.

The best tomographic sections for demonstration of the vocal cords are obtained at 2 and 3 cm. from the skin, at the level of the thyroid notch. The following observations are made on such films:

1. The paralyzed cord is elevated (Figs. 1 and 2). When the arytenoid or corniculate cartilages are well calcified, this elevation will be better demonstrated by the higher position of the calcific density compared to the normal side (Fig. 2).
2. There is better visualization of the ventricle, which appears wider on the paralyzed side (Fig. 3). This is quite evident during phonation and may be seen best with the Valsalva maneuver.
3. The arytenoid and base of the aryepiglottic fold hang toward the normal side and are more prominent on the paralyzed side (Fig. 2).
4. The paralyzed cord is in the mid-line or slightly retracted (Fig. 3). During phonation the normal cord moves

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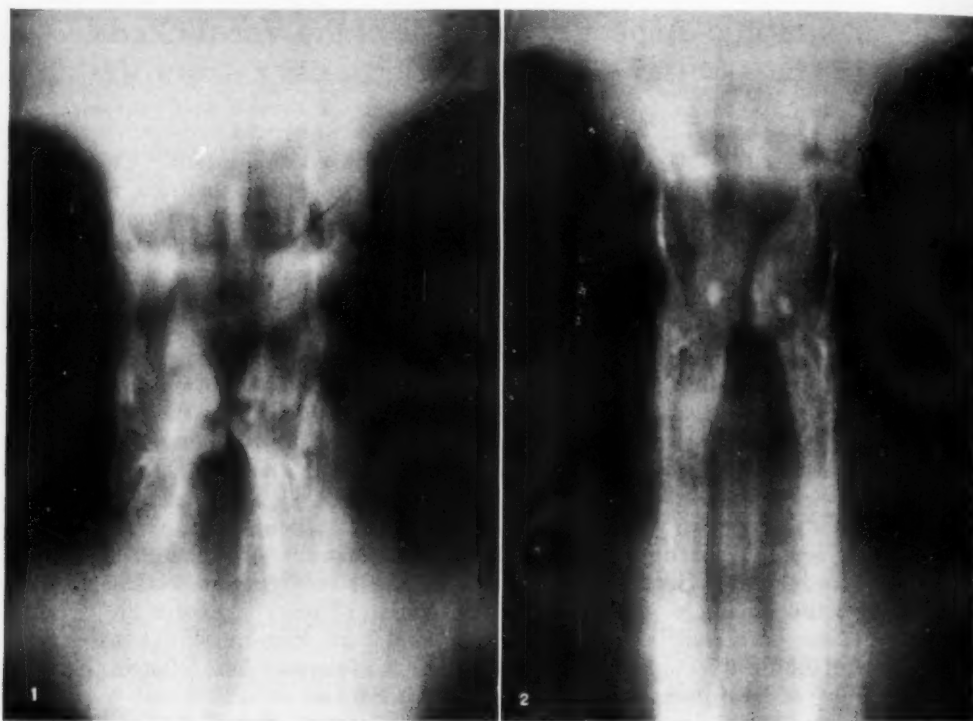


Fig. 1. Paralysis of the left vocal cord. The elevation of the paralyzed cord is evident.

Fig. 2. Paralysis of the right vocal cord. When there is enough calcification in the arytenoid cartilage, its higher position is readily seen.

across to come in apposition with the paralyzed one. In cases of long duration, the normal cord shows compensatory hypertrophy and mobility and appears thicker. In such instances the normal ventricle is very shallow and barely seen (Fig. 4).

5. The bottom of the pyriform sinus is higher on the side of the paralysis. A good demonstration of this finding can be obtained by taking a spot film of the hypopharynx in the anteroposterior position after a barium swallow. It shows the elevation of the pyriform sinus as well as the erect position of the normal arytenoid. It should be noted that in cases of paralysis of the recurrent laryngeal nerve, the swallowing mechanism is preserved and no barium enters the respiratory system. It is

only when there is involvement of the whole vagus nerve, with or without paralysis of the glossopharyngeal nerve, that one sees the opaque material outlining the interior of the laryngeal structures.

6. There is fullness of the subglottic area on the paralyzed side (Figs. 2 and 3). Only occasionally does the subglottic area on the normal side show this fullness.
7. Tomograms taken during the Valsalva maneuver show enlargement or "ballooning" of the pyriform sinus, which gives the impression of partial laryngocele in the membranous portion.

Although no definite proof can be offered at the present time, we are convinced that many of the changes noted in the relative position of the vocal cords and ventricular bands, in paralysis of the cords, especially in cases of tumors of the epiglottis, are

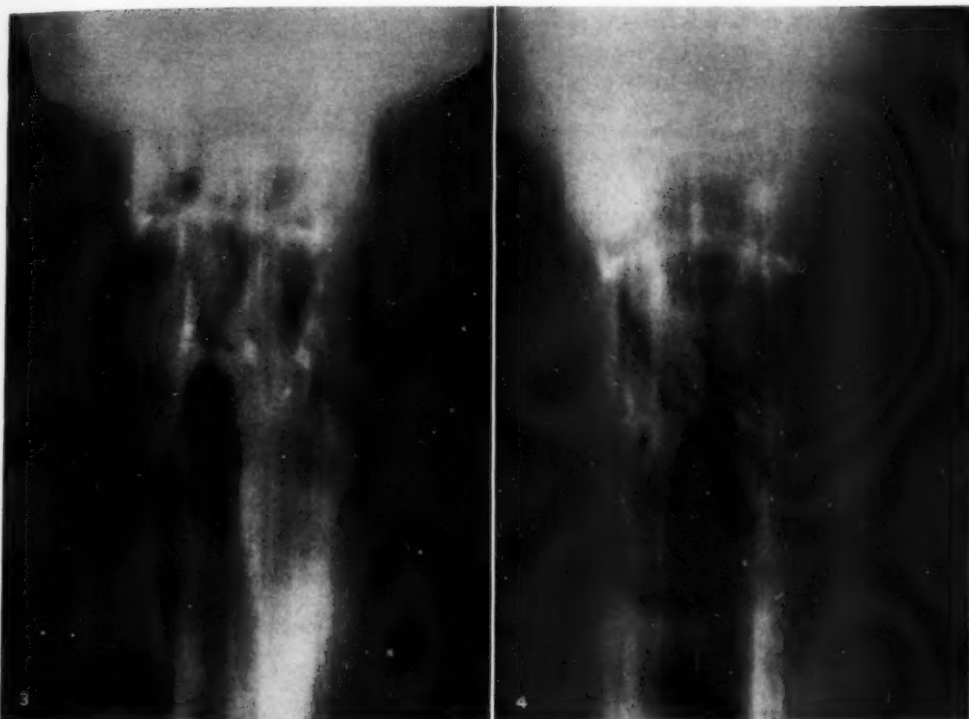


Fig. 3. Paralysis of the right vocal cord. The normal cord moves across the mid-line during phonation to come in apposition with the paralyzed cord.

Fig. 4. Paralysis of the left vocal cord. In cases of long duration there is compensatory hypertrophy of the normal cord. The normal ventricle is barely seen, while that on the side of the paralysis is readily visualized.

due to impaired physiology of the larynx rather than to actual infiltration. We refer particularly to the fact that in many instances of laryngeal tumor, either as a result of mechanical pressure of a bulky growth, or perhaps actual interference with nerve fibers, the tomograms show areas of thickening or abnormality that may not be entirely due to tumor invasion but rather to lack of mobility beyond the infiltrated region. Since the mobility of the larynx can be examined during phonation, in the course of the Valsalva maneuver, and at rest, its tomographic study is being undertaken in malignant tumors of the larynx to evaluate its prognostic significance. A long follow-up will be necessary before results can be reported correlating this exploration with indirect and direct laryngoscopy, which will continue to be, as they have been, the first and most im-

portant means of laryngological diagnosis and prognosis.

CONCLUSIONS

1. Elevation of the vocal cords, a high position of the pyriform sinus, and a widening of the ventricle of Morgagni, on the paralyzed side are among the tomographic signs of paralysis of the recurrent laryngeal nerve.

2. The lateral film of the neck shows neither constant nor sufficient findings for diagnosis in vocal cord paralysis. It should be taken routinely, however, before tomography, as its value in the differential diagnosis of other lesions cannot be denied.

3. The swallowing mechanism of the larynx is preserved in paralysis of the vocal cords. When barium is seen entering the larynx in cases of cord paralysis, a severe involvement of the whole vagus nerve,

with or without paralysis of the glosso-pharyngeal nerve, should be suspected.

ACKNOWLEDGMENT: We are indebted to Dr. F. G. Bloedorn, Associate Radiotherapist of M. D. Anderson Hospital for Cancer Research, for his kind help and advice in the clinico-radiological correlation of the cases studied.

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SUMARIO

Aspecto Tomográfico de la Parálisis de las Cuerdas Vocales

La elevación de las cuerdas vocales, una posición alta del seno piriforme y la dilatación del ventrículo de Morgagni, del lado paralizado, figuran entre los signos tomográficos de la parálisis del nervio laríngeo inferior o recurrente. La radiografía lateral del cuello no revela hallazgos constantes o suficientes para el diagnóstico en la parálisis de las cuerdas vocales. Sin embargo, hay que tomarla sistemáticamente

antes de la tomografía, dado que no cabe negar su valor para el diagnóstico diferencial de otras lesiones.

En la parálisis de las cuerdas vocales, se retiene el mecanismo de deglución de la laringe. En los casos de esta parálisis, cuando se observa el bario penetrando en la laringe, hay que sospechar un compromiso grave de todo el neumogástrico, con o sin parálisis del nervio glossofaríngeo.



Roentgen Findings in a Case of Perforation of the Cecum by a Bone¹

ISADORE KATZ, M.D., and JOSEPH ARCOMANO, M.D.

THE PREOPERATIVE roentgen visualization of sharply pointed foreign bodies which have lodged in or perforated the gastrointestinal tract has been reported only in instances of metallic objects, such as pins, needles, and bobby pins. We have been unable to find in the literature any report of the roentgen demonstration of a bone producing perforation below the level of the esophagus. Indeed, there appears to be no recorded case in which a correct clinical diagnosis was made preoperatively in a patient suffering from an acute or chronic abdominal lesion arising from perforation of the gastrointestinal tract by a fish or chicken bone. The presence of peritonitis, an abscess, or an inflammatory mass in such cases has been revealed only at operation or postmortem.

A case in which films of the abdomen were found on retrospect to demonstrate a bone which had perforated the cecum and produced an abdominal mass is the subject of this report.

CASE HISTORY

F. B., a 50-year-old white male, entered the Brooklyn Veterans Administration Hospital on Oct. 8, 1952, complaining of a mass in the right lower abdomen which had been present for two months. He stated that he had been well until four months prior to admission, when he experienced a sudden onset of cramps in the right lower quadrant and abdominal pain, associated with the passage of six watery, brown stools. The pain and diarrhea lasted twenty-four hours and the patient remained well thereafter until two months prior to admission, when he again experienced mild cramps in the right lower quadrant and on self-palpation discovered an orange-sized mass in this area. During the ensuing month the mass became larger, whereupon he sought medical advice. His physician, however, could find no mass at that time and discharged him without therapy. Approximately one week prior to admission, the patient consulted another physician,

because of persistence of the mass, and was referred for a barium enema examination. The roentgenologist described a large filling defect in the cecum and the patient was admitted to the Veterans Administration Hospital with a diagnosis of "carcinoma of the cecum." On admission he denied recent symptoms of weakness, fatigability, anorexia, weight loss, melena, vomiting, or jaundice.

Physical Examination: The patient was in no acute distress and the only positive finding on physical examination was a well circumscribed, firm, nontender, movable mass in the right lower quadrant.

Laboratory Studies: The admission blood count, urinalysis, and serologic studies were within normal limits. Stool examination for occult blood on three occasions was negative. Liver chemistry, electrolyte studies, bone marrow examination, and an electrocardiogram were also negative. Roentgen examination of the chest and intravenous and retrograde pyelographic studies revealed no abnormalities. A barium enema study disclosed a retrocecal mass displacing the cecum and terminal ileum anteriorly and producing a pressure defect on the cecum posteriorly. At fluoroscopy, the mass could not be separated from the cecum. It was believed to be extra-luminal, although in intimate relationship to the cecum.

Course in Hospital: On the basis of clinical and x-ray findings, the patient was operated on Oct. 30, 1952, with a tentative diagnosis of neoplasm of the cecum. Under endotracheal anesthesia, a hemicolectomy was performed for a colonic mass which was intimately related to the cecum and which could not be differentiated from cancer. This mass involved the mesentery at the angle of the junction of the ileum with the cecum and was firmly adherent to the cecum, posteriorly and medially. The patient was discharged on the tenth postoperative day.

Pathological Specimen: The specimen consisted of a segment of ileum 90 cm. in length and proximal colon 50 cm. in length. In the mesentery, at the ileocecal junction, a stony-hard mass measuring 6 cm. was found adherent to both cecum and terminal ileum. Upon opening the ileum and cecum, normal mucosal folds were found throughout except for an area of "dimpling" 6 cm. above the ileocecal valve on the medial cecal wall. On cut section through this area a fistulous tract could be traced into the firm smooth mass. On cutting through the mass, it was found to be smooth, grayish white and translucent,

¹ From the X-ray Department, Veterans Administration Hospital, Brooklyn, N. Y. Accepted for publication in August 1953. Sponsored by the Veterans Administration and published with the approval of the Chief Medical Director. The statements and conclusions published by the author are a result of his own study and do not necessarily reflect the opinion or policy of the Veterans Administration.

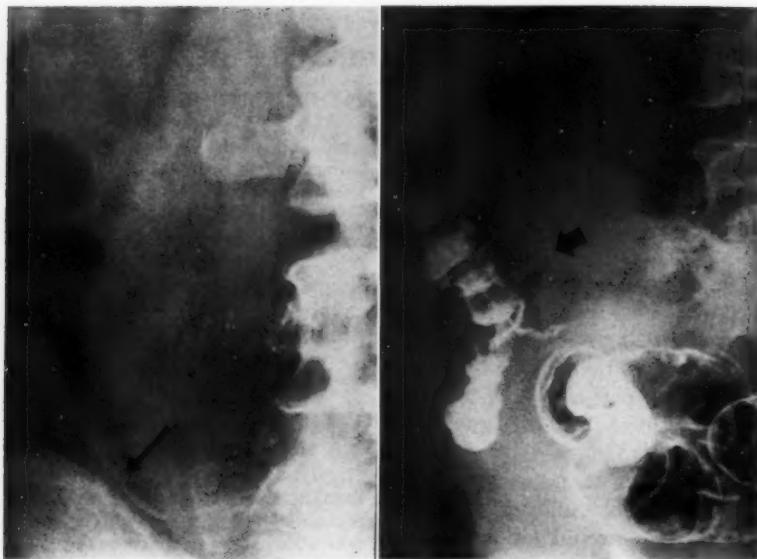


Fig. 1. Anteroposterior film of abdomen. The arrow points to a linear calcific density representing the bone, just above the medial aspect of the right iliac crest.

Fig. 2. Post-evacuation film of barium enema study. In the postero-anterior position the bone (arrow) appears smaller and is less distinctly visualized because of superimposition of the iliac bone.

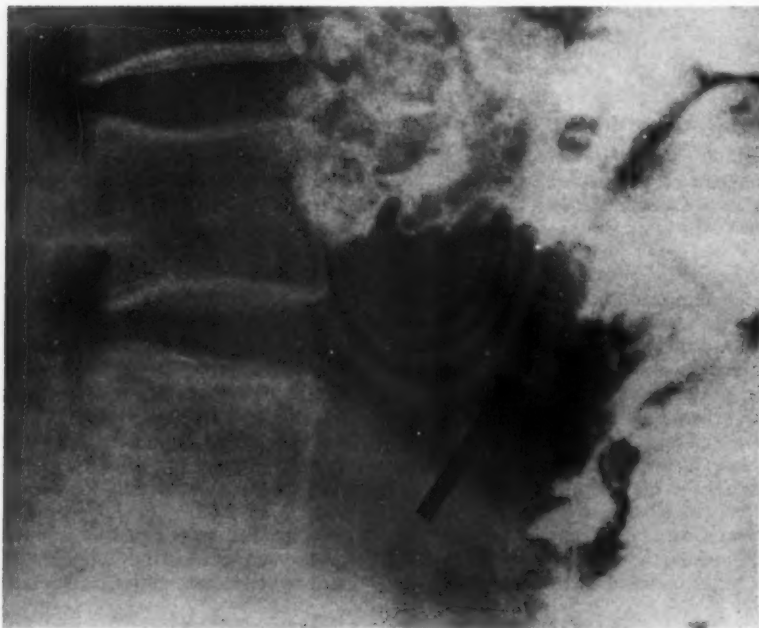


Fig. 3. Lateral film of abdomen, barium enema study. The granulomatous mass has produced a posterior pressure defect and anterior displacement of the cecum. Arrow points to the bone, which lies within the center of the mass.

showing in some areas evidence of fat inclusion. The appendix appeared normal.

Microscopically, the section through the tumor revealed bands and whorls of dense collagenous tissue with many fibroblasts. It was the opinion of the pathologist that the gross changes represented an inflammatory granuloma due to perforation of a diverticulum at the site of the small "dimple" in the cecum. X-ray examination of the surgical specimen

(4, 9, 12-16); the ileocecal region (4, 9, 11-13); the lumen of the appendix (4, 9); the flexures of the large intestine (4, 9, 11).

The ileocecal region is the most common site of perforation and the presenting signs and symptoms in this event are usu-



Fig. 4. Roentgenogram of the surgical specimen. Arrow points to the bone lying in the angle formed by terminal ileum (TI) and cecum (C). The appendix is labeled A.

revealed a foreign body of bony density in the center of the granulomatous mass. Upon further dissection, this proved to be a bone which measured 4 cm. in length and lay in the center of the mass at the distal end of the fistulous tract. Review of the pre-operative roentgenograms revealed a radiopaque linear shadow of bony density in the right lower quadrant (Figs. 1-4), corresponding to the bone found in the operative specimen. Postoperative roentgen studies showed disappearance of the shadow.

DISCUSSION

The ingestion of a foreign body is only rarely associated with acute intra-abdominal signs and symptoms. Patients seldom give a history of having accidentally swallowed a foreign body and the diagnosis is never considered. When a foreign body does cause perforation of the intestinal tract, the site is likely to be one of the following: the junction of the first and second or second and third portions of the duodenum (4, 9); a Meckel's diverticulum

ally those of acute appendicitis (9, 11, 12, 13, 15, 16). It has been observed, however, that the complaints may be referable to an intra-abdominal abscess (5, 8, 9, 11, 12), diffuse peritonitis, asymptomatic tumor (5, 9), vague lower abdominal pains (9, 12), or any combination of the above (5, 9, 11, 12).

As stated previously, a review of the literature shows no case in which the diagnosis of perforation of the intestinal tract by a bone has been made prior to surgery, with or without the aid of roentgen examination. Frimann-Dahl, discussing acute ileus, cites a case of "non-specific granuloma" in which a fish bone that was found at operation was later visualized on re-examination of the original roentgenograms (18). While, the belief has been that most ingested bones are not radiopaque (16), Goldman (7), in his excellent clinical and experimental study of bones lodged in,

or perforating the esophagus, has shown that approximately 75 per cent of fish bones and 72 per cent of chicken bones are demonstrable on roentgenograms of the soft tissue structures of the neck.

We are of the opinion that bones in the gastrointestinal tract should also be visible on roentgenologic examination in some cases. Failure to demonstrate them may be ascribed to the superimposition of the bone on more dense skeletal structures, as the pelvis, spine, or ribs. Properly exposed films in lateral and oblique positions may increase the number of bones demonstrated. Careful examination of survey films of the abdomen, with the possibility of foreign bodies in mind, will undoubtedly increase the accuracy of diagnosis in cases of this kind. Roentgenographic examination of suspicious surgical or post-mortem specimens may bring to light additional cases and clarify instances of perforation where the etiology is obscure.

SUMMARY

A case of perforation of the cecum in which a bone producing the perforation was visible on plain roentgenograms is presented. The patient was operated upon because of an abdominal mass, and the presence of the bone was revealed by roentgen examination of the operative specimen. Subsequent review of the preoperative films showed the bone as a linear shadow in the right lower quadrant. This case illustrates the possibility of a correct preoperative diagnosis in such instances.

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SUMARIO

Hallazgos Roentgenológicos en un Caso de Perforación del Ciego por un Hueso

Preséntase un caso de perforación cecal en que el hueso que la produjo era visible en las radiografías corrientes. El enfermo fué operado debido a una tumefacción abdominal y la presencia del hueso fué revelada por las radiografías del ejemplar operatorio. El estudio subsiguiente de las

radiografías preoperatorias mostró el hueso en forma de una sombra lineal en la fosa ilíaca derecha.

Parece que este caso indica que, en casos de dicho género, puede hacerse el diagnóstico preoperatorio acertado si se tiene presente dicha posibilidad.

EDITORIAL

The Radiological Society of North America An Invitation to the Annual Meeting

The Fortieth Annual Meeting of the Radiological Society of North America will be held at the Biltmore Hotel in Los Angeles, Dec. 5-10, 1954. It is my pleasant duty, as President, on behalf of the officers of the Society and the members of its committees, to invite you, your families, and all interested physicians, to attend this meeting. It was my hope that this meeting might be held in Philadelphia, but a strong contingent from California convinced our Board of Directors that we would lose the opportunity of a lifetime if we did not go to Los Angeles. The local committees as well as the regular committees of the Society are working diligently, and I can promise not only that our program will be outstanding, but that the local committee will provide opportunities for entertainment that would be difficult to secure elsewhere.

All of the scientific sessions will be in the Biltmore Hotel, as well as the refresher courses, the scientific exhibits, and the commercial exhibits. As usual, the refresher courses, under the direction of Dr. John W. Walker and his committee, will begin on Sunday afternoon and evening and continue daily from 8:30 to 10 A.M. Dr. Walker has secured a number of new features for these courses which, plus some of the indispensable contributors who have served us in the past, assure the success of this portion of our meeting. Dr. Edith H. Quimby, of Columbia University, is again in charge of the refresher courses on the radiobiological aspects of radiology. This is becoming an increasingly important feature of our Annual Meeting.

The scientific sessions will be conducted

in three sections: Section A, Diagnostic Radiology, running concurrently with Section B, which is devoted to Therapy and Radiobiology. Section AB will deal essentially with problems which are of interest to all radiologists. The scientific sessions will begin each morning at 10:30 and will close at 12:00 o'clock, except on Friday, when the meeting closes at 1:00 o'clock. The afternoon sessions will begin at 2:00 o'clock and will close at 4:30 on those days on which the executive meetings of the Society are held. On the other days, except Friday, the closing hour will be 5:00 o'clock.

The annual "Carman Lecture" will be given on Tuesday evening by Dr. Barton R. Young, of Philadelphia, on the "Acute Abdomen."

Business meetings of the Society will be held on Monday, Tuesday, and Thursday afternoons. This is a time set aside for you, as members, to participate in the important business aspects of our Society. Be sure to attend these meetings.

Los Angeles County is a fabulous region of 4,080 square miles, served by seven scheduled airlines and three transcontinental railroads. The temperature ranges are moderate around the calendar. There is no snow or ice except in nearby mountain resorts. Even at Christmas time a light coat for evening is sufficient. Thus one can travel light. We are told that no other place in the world offers so many things to do. There is a choice of outdoor activities the year round, including golf, tennis, swimming, and horseback riding. One can motor from seashore to mountain and desert and return in a single day.

One can fish or cruise in his choice of the deep-sea fleet. The camera fan will find here a paradise.

Ample hotel facilities are available in Los Angeles, but it will be well to make reservations as early as possible.

Dr. William E. Costolow is the chairman of the local committee, and if there is any-

thing special that you want he will try to arrange it.

The meetings of the Radiological Society are invariably excellent. This one promises to hit a new high.

Come and see.

EUGENE P. PENDERGRASS, M.D.
President

The Radiologist in the Small Community

There can be no quarrel with Dr. E. D. Greenberger (*Radiology in a Small Community*, RADIOLOGY 62: 88-90, 1954) if he chooses "a statistical report" of the type and amount of work that has been available to him to show that "the practice of radiology in a small community is stimulating, satisfying, and profitable," and to encourage the young radiologist toward that type of practice. This is certainly one facet of the problem. One may, however, use a different primary approach to accomplish these ends, pointing out what, for want of a better word, we may call the *charms* of practicing in a small community.

1. *Charms stemming from the radiologist's relationship with his patients:* In a practice consisting of 20 patients a day, the radiologist can see practically everyone. The patient-doctor relationship, the loss of which is so commonly lamented by radiologists, is at once established. The patients are keen to sense one who is interested in their complaints, and they respond by making him "their doctor" in a status similar to the referring physician. There is absolutely no need to lose this relationship. Indeed, in the dark privacy of the fluoroscopic room, the patient may divulge information to the unhurried radiologist that even the referring physician has not received.

Personal contact with the patient may lead the radiologist to modify or supplement (but never substitute) the examination requested by the referring doctor. It is thrilling to uncover a lumbar vertebral

body fracture when examination of only the foot and ankle was mentioned, or to dispel the fears of the patient with a hard stony mass in the neck just caudal and anterior to the mastoid process with the knowledge that this is simply the transverse process of the first cervical vertebra. Such examples could be multiplied many fold.

In the establishment of this relationship with the patient, the radiologist must give, as well as take. Just as he may receive patient-recognition for an obvious—or not so obvious—radiologic diagnosis, so must he be prepared to answer personally to the patient and his family for any errors, whether or not these merit the censure of his peers. While this may not be entirely just, it is a much better atmosphere than a complete renunciation of moral responsibility to the patient.

2. *Charms stemming from the radiologist's relationship with the referring physicians:* To pervert Francis Bacon's "reading maketh a full man," responsibility maketh a full radiologist. This fullness varies directly with the responsibility placed upon him. By virtue of his training, the radiologist is responsible for the radiologic well-being of his whole community. Those physicians, usually in the submedical and subsurgical specialties, who can—or believe they can—compete with or surpass the well trained radiologist in film interpretation are usually not to be found in the smaller communities. It is he, therefore, who is largely responsible for the oftentimes

vital information to be obtained from a diagnostic medium that transects each and every specialty. To fulfill this function, he should be thoroughly conversant with all of the disciplines practiced in his medical community. This is an unobtainable ideal, but a challenge infinite in its capacity for stimulation. In proportion as the radiologist meets it, so does he meet his obligations to the medical and lay community. In no other type of radiologic practice is this challenge thrown into such bold relief. How to meet it leads us to the third group of *charms*.

3. *Charms stemming primarily from within the radiologist himself:* The radiologist of the small community, not burdened with the demands of teaching, administration, and formal research, should have an abundance of time for self-improvement not given to his non-radiologic colleagues. He has the time at least to scan a representative journal of each of the major specialties, and to read more carefully those articles of immediate importance to him as a radiologist. He has the time to read carefully all articles of interest to him in the domestic and foreign radiologic journals. This last is not as formidable an undertaking as it first appears, since much of this material is of no immediate interest to the general practitioner of radiology, and can be skipped with impunity. The notices of book publishers should be inspected carefully, and those volumes purchased which are of aid in the general practice of radiology. A surprisingly large number have little to do with the narrow aspects of roentgenographic shadows and densities, but abound in general medicine. Only

with such invaluable tools will the radiologist become a true consultant.

The radiologist must, of course, be vitally interested in the clinic. In the small community he must be on call for all abdominal and obstetric examinations, day or night. How much richer this makes him as a clinician—to do the radiologic examination of the acute surgical abdomen in the middle of the night, to find free gas in only the transabdominal view of the four projections (which in all probability even the best trained surgeon would have missed), to be perhaps the first assistant at the operation, and to be able to see and touch these mis-fired experiments of nature. Or, instead of free gas, to find a small laminated calculus in the right lower quadrant, and to predict that, in spite of the patient's severe midepigastic pain, the surgeon will find an obstructive appendicitis, with perforation imminent or actual, rather than a perforated peptic ulcer. Or, in the occasional case, in which no definite radiologic preoperative diagnosis is possible to see a massive infarct of the intestine at operation, and to follow it to the autopsy table, the teaching cycle thus being completed. Or to witness the accuracy—or inaccuracy—of one's predictions of the mechanism of labor or the implantation of the placenta. Such opportunities for self-instruction could be enumerated without end. All that is required is to take advantage of them.

It is thus that I would show the young radiologist how "stimulating, satisfying, and profitable" may be the practice of specialty in a small community.

CHRISTIAN V. CIMMINO, M.D.
Fredericksburg, Va.



REFRESHER COURSES: POSTGRADUATE INSTRUCTION

The 1954 Refresher Course Series will be presented during the Fortieth Annual Meeting of the Radiological Society of North America at the Biltmore Hotel, Los Angeles, Calif. The courses will open at 2:30 P.M., Sunday, Dec. 5, and this opening session will be followed by a Film-Reading Session at 7:00 P.M. Commencing on Monday, Dec. 6, there will be seven courses daily from 8:30 to 10 A.M. No other meetings will be scheduled during these hours. Attendance is limited to the medical profession, including graduate students and residents in radiology; radiation physicists, radiobiologists, chemists, and others closely concerned with the science of radiology; and medical students certified by the deans of their respective medical schools.

A registration fee of \$15.00, which includes the Refresher Course fee, must be paid by all non-members of the Radiological Society of North America at the time of registration at the Biltmore Hotel. The exceptions are guest speakers, guest instructors, scientific exhibitors, residents or fellows in radiology,

medical students, trainees in physics, and officers in the Armed Forces of the United States on temporary duty and away from their practice. Members of the Radiological Society of North America do not pay a registration fee or a Refresher Course fee. All must register at the R.S.N.A. registration desk in the Biltmore Hotel. Admission to the Refresher Courses will be by presentation of the registration badge and a ticket for the particular course. Payment of registration fee by non-members is not to accompany the request for tickets but is to be paid when the tickets are called for at the registration desk. If you cannot use tickets you have reserved, please notify the Chairman of the Refresher Course Committee.

Read the description of the courses, noting particularly the days they are offered, and make your selection for each day. State your first, second, and third preferences. The number attending each course will be limited by the seating capacity of the room. You will be notified regarding your selections. Please pick up tickets at the registration desk.

Course No. 1: 2:30-4:30 P.M., Sunday

Fundamental Problems in the Clinical Use of Isotopes

SIMEON T. CANTRIL, M.D., Seattle, Wash.

Moderator

HENRY L. JAFFE, M.D., Los Angeles, Calif.
DONALD S. CHILDS, JR., M.D., Rochester, Minn.
PAUL AEBERSOLD, Ph.D., Oak Ridge, Tenn.
LEON O. JACOBSON, Ph.D., Chicago, Ill.
HOMER HIEBERT, M.D., Topeka, Kans.
EDITH H. QUIMBY, Sc.D., New York, N. Y.

Despite urging from the national radiological societies and the American College of Radiology to get into the field of radioactive isotopes, the individual radiologist in the great majority of cases has remained apathetic and indifferent. It has been thought in the past that these isotopes were a fad and a "passing fancy." It is now apparent that they are here to stay and they are now recognized as a new and important tool in the field of diagnosis and in some phases of therapy.

This program will consist of a series of problems confronted daily in clinical use of isotopes. It has two purposes: first, to show the general practitioner of radiology the common problems that can be solved today with a minimal outlay of equipment and, secondly, thus to stimulate the radiologist to enter the field.

The panel will not delve into complex problems that can be handled only in laboratories with expensive equipment, but with the simple ones which can be considered "tried and true" and in daily practice today.

Course No. 2: 7-9 P.M., Sunday

Film Interpretation Session

L. HENRY GARLAND, M.D., San Francisco, Calif.

Moderator

WENDELL G. SCOTT, M.D., St. Louis, Mo.
BERNARD J. O'LOUGHLIN, M.D., Los Angeles, Calif.
LEO G. RIGLER, M.D., Minneapolis, Minn.

This session is a diagnostic symposium designed to illustrate basic principles of film interpretation, including differential diagnosis. Only proved cases will be shown, and all will be diagnosable either from the films, the history, the fluoroscopic findings, or a combination of these data.

The cases will be chosen largely from material submitted by members of the Pacific Roentgen Society. However, any member of the Radiological Society who desires to present an instructive case may submit his material to the moderator, Dr. L. Henry Garland, 450 Sutter St., San Francisco 8, Calif.

Course No. 3: 8:30-10 A.M., Monday

Technics of Pediatric Radiology

JOHN W. HOPE, M.D.

Children's Hospital of Philadelphia
Philadelphia, Penna.

Infants and children, and the diseases of infants and children, differ greatly from adults and the diseases of adults. Most departments of radiology in general hospitals work and think in terms of adults. Children, particularly infants, are considered neces-

sary evils, to be examined without much enthusiasm on the part of the technician and the radiologist. This course is designed to point out the fallacy of this point of view by presenting simple methods of obtaining diagnostic studies of the chest, neck, gastrointestinal tract, genitourinary tract, skull, and extremities in these young patients.

Course No. 4: 8:30-10 A.M., Monday

Basic Radiation Dosimetry

H. M. PARKER

Richland, Wash.

Nucleonics Division, General Electric Company

1. Influence of spatial and temporal distribution of ionizing events in tissue.
2. Energy absorption in tissue as the basis for dosimetry.
3. Direct measurement of energy absorption—calorimetry.
4. Indirect measurement of energy absorption—the Bragg-Gray principle.
5. Relationship of the roentgen to this principle.
6. Extension of dosimetry to particulate radiation.
7. Use of the term "rep."
8. Dosimetry of radioisotope distributions in tissue—the "infinite mass" simplification.
9. Simple modifications of the infinite mass case.

Course No. 5: 8:30-10 A.M., Monday

Treatment of Cancer of the Cervix

JUAN A. del REGATO, M.D.

Colorado Springs, Colo.

Carcinoma of the cervix is the most curable major form of cancer. Although the early lesions can be cured by local applications of radium and by surgery, the overwhelming majority of carcinoma of the cervix requires an intelligent adaptation of external and internal treatment which will yield best results in advanced as well as in early cases.

It is in the utilization of external pelvic therapy that the improvement of results usually lies.

Course No. 6: 8:30-10 A.M., Monday

Roentgen Cardiology

MELVIN M. FIGLEY, M.D.

Ann Arbor, Mich.

This course will consider in detail the examination of the heart and intrathoracic vessels by fluoroscopy and simple roentgenography. Particular attention will be given to the signs of enlargement of the individual chambers of the heart and to the assessment of alterations in pressure and flow in the vessels. Angiocardiograms will be used liberally to illustrate alterations in morphology and function.

As it will be impossible to consider the roentgen aspects of every type of cardiac disease, attention will be given principally to those types where relatively specific signs are encountered and to those types of acquired and congenital disease of surgical importance. An attempt will be made to indicate both the potentialities and the limitations of these simple methods of cardiac diagnosis.

(This course continued Tuesday, Course No. 13)

Course No. 7: 8:30-10 A.M., Monday

Fundamental Principles of Radiation Chemistry

M. A. GREENFIELD, Ph.D.

Los Angeles, Calif.

- I. The Primary Act
Radiation absorption and energy loss by primary and secondary particles
- II. Actinometry and Radiolysis of Pure Liquids
Actinometry of ionizing radiation, dosimetry, chemical phenomena in irradiated pure water
- III. Indirect Action
Mechanism of radiochemical changes in aqueous dilute solutions
- IV. Theories concerning the mechanism of the action of penetrating rays on living cells

(Material for this lecture is largely taken from the following sources: (1) Faraday Society Discussions No. 12, 1952, on Radiation Chemistry; (2) "Radiations and Living Cells," F. G. Spear, John Wiley & Sons, 1953.)

Course No. 8: 8:30-10 A.M., Monday

Duodenal Ulcer

ARTHUR FINKELSTEIN, M.D.

Philadelphia, Penna.

An informal review of the diagnostic criteria for duodenal ulcer. The importance of the crater, and methods of demonstrating it. Relative importance of fluoroscopy and radiography. Spot-filming and compression. Differentiation between a crater and barium caught between distorted folds. Evaluation of "secondary signs." Recognition of complications. Criteria of healing.

This will be a lantern slide demonstration, and will terminate with a question and answer period.

Course No. 9: 8:30-10 A.M., Monday

Roentgenological Aspects of Painful Hip Conditions in Adults

GEORGE D. DAVIS, M.D.

Mayo Clinic, Rochester, Minn.

Because of advances in remedial surgery, increasing attention is given by orthopedists to painful

afflictions in and about the hip joints in adults. Hence it is pertinent for the roentgenologist to refresh his knowledge of the basic causes of such complaints and their distinguishing roentgenologic features, and to review the principal surgical reconstructive procedures that he is likely to see and have to evaluate.

Consideration will be given to roentgenologic differentiation of congenital and developmental affections and their late sequelae, the arthritides, tumors, trauma, and degenerative changes.

Course No. 10: 8:30-10 A.M., Tuesday

Medical-Legal Problems

RAOUL D. MAGAÑA, Lawyer

Los Angeles, Calif.

A discussion of the timely problem of the increasing number of law suits brought against doctors by patients, and pointers for radiologists in particular, both for avoiding suits and proper handling of a suit.

This will include: some "do's" and "don'ts" in writing up daily reports, keeping patients' charts or histories, terminology that cannot be misread; actual testimony and personal conduct of the radiologist in the court room; giving a deposition; how to work with your lawyer to obtain the most satisfactory counsel.

Course No. 11: 8:30-10 A.M., Tuesday

Roentgen Diagnosis of the Arthropathies

A. A. de LORIMIER, M.D.

Saint Francis Memorial Hospital, San Francisco, Calif.

Casual observation of roentgenograms of joints may lead one to identify most cases either as atrophic or hypertrophic "arthritis." This stunted point of view may be due to improper technical precaution; it may be due to lack of comprehensive thinking with respect to the common types of arthropathies; it may be due to oversight of tangible roentgen criteria. These three aspects of responsibility on the part of roentgenologists will be considered, with portrayals by lantern slides.

The Peripheral Joints

Developmental Malformations

Osteochondritis

Specific

Congenital syphilis

Rickets

Scurvy

Non-specific

Juvenile types: Legg-Perthes, Osgood-Schlatter, Köhler's, Freiberg's infraction, Sever's disease, etc.

Adult types

Group in Which Changes Are Essentially Concerned with Mechanical Stresses

Degenerative joint disease—osteoarthritis

Traumatic

Static

Senescent

Hemorrhagic arthropathies

Neuroarthropathies

Concerned with efferent nerve loss

Concerned with afferent nerve loss

Paraplegic joints

Group Essentially Concerned with Protein Reactions, Toxins, or Actual Bacterial Invasion of the Joint—True Arthritides

Peritendinitis, tendinitis

Allergic arthropathies, including rheumatic fever

Toxin arthropathies: rheumatoid arthritis

Infectious arthritis

Gout

Neoplasms Benign and Malignant

Peripheral Arthralgias: Miscellaneous Causes

The Joints of the Spine

Developmental Malformations

Spondylolisthesis

Osteochondritis

Group in Which Changes Are Essentially Concerned with Mechanical Stresses

Degenerative Joint Disease—Osteoarthritis

Traumatic

Static

Senescent

Neuroarthropathies

Concerned with efferent nerve loss

Concerned with afferent nerve loss

Group Essentially Concerned with Protein Reactions, Toxins or Actual Bacterial Invasion of the Joint

Toxin arthropathies: rheumatoid spondylitis

Infectious arthritis

Ochronosis

Neoplasms

Spinal Arthralgias: Miscellaneous Causes

The Temporomandibular Joints

Arthropathies: Traumatic, Rheumatoid, Infectious

(This course continued Wednesday, Course No. 18)

Course No. 12: 8:30-10 A.M., Tuesday

Problems and Pitfalls in X-ray Calibrations and Protection Surveys

ROBERT E. PUGH

Pasadena, Calif.

This discussion will assume familiarity with general calibration and survey procedures, such as candidates for examination by The American Board of Radiology are expected to know. It will be concerned principally with possible reasons for discrepancies and will consider precautions and tests to assure proper functioning of instruments and possible x-ray equipment troubles which could ex-

plain abnormal readings. It will also include special precautions necessary for calibration of some of the newer types of x-ray equipment, survey of stray radiation near medical x-ray equipment, and some of the problems of surveys of industrial equipment, since in some isolated communities, in the absence of a physicist, a radiologist might be consulted regarding protection.

Course No. 13: 8:30-10 A.M., Tuesday
Roentgen Cardiology
MELVIN M. FIGLEY, M.D.

(Continued from Monday, Course No. 6)

Course No. 14: 8:30-10 A.M., Tuesday
What the Chief Should Teach His Young
Braves About the Ethics and Economics of
Radiology

W. EDWARD CHAMBERLAIN, M.D.
Temple University Medical School and Hospital
Philadelphia, Penna.

Relationship of the Radiologist to his Patient: In private office practice; in a hospital department of radiology; factors that may affect such relationship (for example, the effect of having the radiologist's fee collected by the hospital).

Hospital-Radiologist Relationships: In respect to departmental administration (equation number one, "responsibility minus authority equals frustration"); in respect to the method by which the radiologist is compensated; why it is best for the radiologist to collect his own fees. Selected examples of what happens to the hospital radiologist under certain conditions. Exhibit of "impossible," bad, fair, good, and exceptionally good forms of contract, or working agreement, with examples. Exhibit of good and not-so-good bookkeeping methods.

Satisfactory hospital-radiologist relationships tend to bring top-notch radiologists into hospital practice; unsatisfactory arrangements tend to drive top-notch radiologists into private office practice, thus depriving hospital in-patients of their right to the best in medical care. Where unsatisfactory hospital-radiologist relationships exist, how much of the fault lies with the radiologist and how much with the hospital? How shall we answer the charge that "the hospital radiologist has a monopoly?"

How can the young radiologist establish himself in hospital practice on a fair and equitable basis? The advantages of being employed at the time one is negotiating with hospital management. The young man should stay in an "associateship" until he has developed the requisite stature and reputation to enable him to stand up to the hospital authorities with whom he is negotiating. All too frequently the error is made of accepting an unsatisfactory arrangement in the expectation of re-negotiation "in another year." Experience proves that the radiol-

ogist's only chance to get a proper contract is when he first starts.

The impact upon radiology of Blue Cross hospitalization insurance plans, the nefarious "all-inclusive, flat-rate" method of hospital billing, etc.

(Course to be repeated—not continued—Thursday)

Course No. 15: 8:30-10 A.M., Tuesday
X-raying the Stomach (Special Technics)

ARTHUR FINKELSTEIN, M.D.
Philadelphia, Penna.

The importance of preliminary removal of non-opaque residue; methods employed, including asstringent lavage. Use of respiratory movement in differentiating extrinsic pressure from intrinsic lesions. Multiple exposures during swallowing, for detection of small or sliding hiatal hernias. Overdistention technic for demonstration of regurgitation in the study of pyrosis. Combined filling of stomach and colon in the evaluation of the splenic flexure syndrome. Various methods for producing double-contrast visualization of the fundus. Pharmacoradiology.

This will be a lantern slide demonstration, and will terminate with a question and answer period.

Course No. 16: 8:30-10 A.M., Tuesday
Radiobiology—Radiological Safety for Doctor
and Patient

RAYMOND L. LIBBY, Ph.D.
Los Angeles, Calif.

The principles and problems involved in maintaining a radiologically safe environment for both the doctor and the patient in the clinical use of radioactive isotopes will be discussed. Specifically, the radiological safety problems involved in the handling and administration of millicurie amounts of iodine-131, gold-198, and phosphorus-32 will be considered. The properties of the radiation from these radioisotopes and various protective measures will be examined by demonstration.

Course No. 17: 8:30-10 A.M., Wednesday
The Radiation Treatment of Carcinoma of the
Cervix Uteri

EDWIN C. ERNST, M.D.
St. Louis, Mo.

The clinical and technical treatment approach, together with a practical discussion of the advantages and disadvantages of the various radiation therapy methods employed in this country and abroad will be evaluated and the results compared in the light of more recent radium dosage research investigations.

SUNDAY, Dec. 5 2:30-4:30 P.M.	MONDAY, Dec. 6 8:30-10 A.M.	TUESDAY, Dec. 7 8:30-10 A.M.
1. Fundamental Problems in Clinical Use of Isotopes Simeon T. Cantril, M.D., Moderator Henry L. Jaffe, M.D. Donald S. Childs, Jr., M.D. Paul Aebersold, Ph.D. Leon O. Jacobson, Ph.D. Homer Hiebert, M.D. Edith H. Quimby, Sc.D.	3. Technics of Pediatric Radiology John W. Hope, M.D.	10. Medical-Legal Problems Raoul D. Magaña, Lawyer
	4. Basic Radiation Dosimetry H. M. Parker	11. Roentgen Diagnosis of the Arthropathies (continued on Wednesday) A. A. de Lorimier, M.D.
	5. Treatment of Cancer of the Cervix Juan A. del Regato, M.D.	12. Problems and Pitfalls in X-ray Calibrations and Protection Surveys Robert E. Pugh
7-9 P.M.	6. Roentgen Cardiology (continued Tuesday) Melvin M. Figley, M.D.	13. Roentgen Cardiology (continued from Monday) Melvin M. Figley, M.D.
2. Film Interpretation Session L. Henry Garland, M.D., Moderator Bernard J. O'Loughlin, M.D. Leo G. Rigler, M.D. Wendell G. Scott, M.D.	7. Fundamental Principles of Radiation Chemistry M. A. Greenfield, Ph.D.	14. What the Chief Should Teach His Young Braves About the Ethics and Economics of Radiology W. Edward Chamberlain, M.D.
	8. Duodenal Ulcer Arthur Finkelstein, M.D.	15. X-raying the Stomach (Special Technics) Arthur Finkelstein, M.D.
	9. Roentgenological Aspects of Painful Hip Conditions in Adults George D. Davis, M.D.	16. Radiobiology — Radiological Safety for the Doctor and Patient Raymond L. Libby, Ph.D.

PLAN OF PRESENTATION

Dec. 7 A.M.	WEDNESDAY, Dec. 8 8:30-10 A.M.	THURSDAY, Dec. 9 8:30-10 A.M.	FRIDAY, Dec. 10 8:30-10 A.M.
Problems gaña, Lawyer	17. The Radiation Treatment of Carcinoma of the Cervix Uteri Edwin C. Ernst, M.D.	24. What the Chief Should Teach His Young Braves About the Ethics and Economics of Radiology (repeated, not continued) W. Edward Chamberlain, M.D.	31. The Key Area (Attic-Aditus-Antrum) in the Chronic Mastoid Gilbert R. Owen, M.D.
gnosis of the (continued on	18. Roentgen Diagnosis of the Arthropathies (continued from Tuesday) A. A. de Lorimier, M.D.	25. Design and Equipment of Radioisotope Laboratories G. W. Morgan	32. Pediatric X-ray Diagnosis Raymond R. Lanier, M.D.
mier, M.D.	19. Departmental Planning for a Disaster Ted F. Leigh, M.D.	26. Treatment of Cancer of the Lower Lip Juan A. del Regato, M.D.	33. Cerebral Angiography Howard L. Steinbach, M.D.
Pitfalls in L s and Protec	20. Recent Advances in Clinical Radioisotope Techniques Frank E. Hoecker, Ph.D.	27. A Simplified System for the Development and Control of Radiographic Quality John H. Freed, M.D.	34. Myelography Harold O. Peterson, M.D.
h	21. The Statistical Point of View Harold Tivey, M.D.	28. Radium and Radioisotope Dosimetry Elizabeth F. Focht	35. High-Energy Accelerators and Some of Their Medical Applications Gail Adams, Ph.D.
diology (con nday)	22. Radiation Therapy in the Management of the Lymphomas Simeon T. Cantril, M.D.	29. Methods of Dosimetry and Methods of Clinical Utilization of Cobalt 60 by Interstitial, Intracavitary and Plaque Techniques Isadore Meschan, M.D. Gilliam Brogdon, M.D. Neil Crow, M.D.	36. Examination of the Colon Henry C. Crozier, M.D.
Should Teach es About the conomics of	23. Some Fundamentals in Chest Roentgen Interpretation (continued Thursday) Benjamin Felson, M.D.	30. Some Fundamentals in Chest Roentgen Interpretation (continued from Wednesday) Benjamin Felson, M.D.	37. Control of Roentgenographic Diagnostic Procedures with Particular Attention to Film Processing George C. Henny, M.D.
Chamberlain,			
nach (Special			
ein, M.D.			
Radiological Doctor and			
oby, Ph.D.			

Furthermore, a recently completed comprehensive series of radium dosage charts will be presented and their employment evaluated to meet the *different* requirements of the various cervical cancer distribution problems.

The frequent clinical "question" and "answer" periods will include a discussion of the many technical problems involved for minimizing "early" and "delayed" injuries to the normal structures of the pelvis when the full complement of adequate radium and x-ray dosages are employed.

Course No. 18: 8:30-10 A.M., Wednesday

Roentgen Diagnosis of the Arthropathies

A. A. de LORIMIER, M.D.

(Continued from Tuesday, Course No. 11)

Course No. 19: 8:30-10 A.M., Wednesday

Departmental Planning for a Disaster

TED F. LEIGH, M.D.

Emory University, Ga.

Destruction of American cities by thermonuclear devices or by natural phenomena (earthquakes, etc.) is possible. A department of radiology which might be destroyed or damaged in such a disaster can still be effective if careful planning has been made in advance. The course will cover such topics as the estimated damage from ground zero, the safeguarding of supplies (particularly film from radiation), the use of personnel in the department or their relocation in other departments, the making of films when the usual power and water supplies are unavailable, record keeping and film reporting in the emergency.

Course No. 20: 8:30-10 A.M., Wednesday

Recent Advances in Clinical Radioisotope Technics

FRANK E. HOECKER, Ph.D.

Lawrence, Kans.

This course is intended for the physician interested in initiating a clinical isotopes program, and for the physician interested in improved methods of diagnosis and treatment by means of radioactive isotopes.

Essential equipment will be discussed from the point of view of (1) adaptability to the clinical objective, (2) simplicity and dependability, (3) laboratory time of the physician and technician.

The interdependence of radioisotope technic and clinical objectives will be given careful consideration, especially in relation to diagnostic procedures. Widely accepted as well as recently published methods will be discussed in the light of their appropriateness to the accomplishment of certain clinical objectives.

Course No. 21: 8:30-10 A.M., Wednesday

The Statistical Point of View

(How to look at a statistic in the face with equanimity)

HAROLD TIVEY, M.D.

Portland, Ore.

The purpose of this course is to review, in a non-mathematical fashion, those statistical methods useful to the practicing radiologist in both the evaluation of his own results and the equally critical examination of the published work of others.

A brief appraisal of some current methods of presentation of data will be given, with particular emphasis on the basic concepts, the implications of such methods, and the logical pitfalls which may be encountered by both the investigator and his readers. The intent is to enable us to face the ordinary statistics with adequate equanimity and deserved skepticism.

The general problem of evaluation of survival time data in patients with malignant disease will be discussed. There are now available methods by which the proportion of patients cured and the times of death of those patients not cured may be predicted long in advance of the ultimate outcome of the series. Such predictions appear to be reliable within the confidence limits which can be placed upon the results of the usual series of 100 patients if the analysis is made as early as the time required for the first half of the patients in the series to die. (For many tumors, this interval will be less than three years after the last patient of the series is treated.) These methods will be presented by means of appropriate examples.

Mimeographed notes and references will be furnished those who wish to explore such problems in greater detail.

Course No. 22: 8:30-10 A.M., Wednesday

Radiation Therapy in the Management of the Lymphomas

SIMEON T. CANTRIL, M.D.

Seattle, Wash.

The discussion will be related to the lymphomas (exclusive of leukemias). Problems relating to diagnosis, irradiation, and chemotherapy will be presented in relation to specific case problems. Since there are varying opinions and practices regarding methods of irradiation, the views expressed are those which have evolved from our own experience at the Tumor Institute of the Swedish Hospital (Seattle).

Variations in management dependent upon the state of lymphoma and the variety of disease, whether Hodgkin's disease, lymphosarcoma, or giant-follicle lymphoma, will be discussed from the standpoint of irradiation. Time will be allowed for questions and group discussions.

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REFRESHER COURSES

THE RADIOLOGICAL SOCIETY OF NORTH AMERICA

December 5 through December 10, 1954

BILTMORE HOTEL

LOS ANGELES, CALIF.

(Detach here)

SEE INSTRUCTIONS ON REVERSE SIDE

FILL OUT THE FOLLOWING

(Print or type).....M.D.

Last Name

First Name or Initials

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Street Address

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City

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State

CHECK THE FOLLOWING

Member R.S.N.A. ☐

Guest ☐

Resident or fellow in Radiology at present ☐

Where.....

Medical Student ☐

Where.....

Reserve Officer on Active Duty at present ☐

Trainee in Physics ☐

Fill out, also, the enrollment diagram on the reverse side of this page

INSTRUCTIONS FOR ENROLLMENT IN REFRESHER COURSES

Read the accompanying description of the courses and plan of presentation. Register early; the number admitted to each course will be limited by the seating capacity of the rooms. Reservations will be made in the order of the receipt of request.

Courses are limited to the medical profession, including graduate students and residents in radiology; radiation physicists, radiobiologists, chemists, and others closely concerned with the science of radiology; and medical students certified by the deans of their respective colleges.

All tickets will be held for you at the R.S.N.A. Registration Desk in the Biltmore Hotel.

The registration fee, where applicable, will cover the cost of the Refresher Courses. Members, guest speakers, guest instructors, scientific exhibitors, residents or fellows in radiology, medical students, members of the Armed Forces, and trainees in physics do not pay a registration fee. Non-members not in these groups will pay a registration fee of \$15.00, which will include the Refresher Courses.

PLEASE INDICATE YOUR FIRST, SECOND AND THIRD CHOICES

	First Choice		Second Choice		Third Choice	
	Course No.	Instructor	Course No.	Instructor	Course No.	Instructor
Sunday, Dec. 5						
2:30 P.M.						
7 P.M.						
Monday, Dec. 6						
Tuesday, Dec. 7						
Wednesday, Dec. 8						
Thursday, Dec. 9						
Friday, Dec. 10						

Mail this order sheet to John W. Walker, M.D., Chairman, Refresher Course Committee
Prior to Dec. 1, 830 Argyle Bldg., Kansas City 6, Mo.
After Dec. 1, c/o Radiological Society of North America, Biltmore Hotel, Los Angeles, Calif.

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Course No. 23: 8:30-10 A.M., Wednesday
Some Fundamentals in Chest Roentgen Interpretation

BENJAMIN FELSON, M.D.
Cincinnati, Ohio

Chest roentgen interpretation should not merely represent an attempt to correlate particular shadows with specific diseases, but should be approached with an understanding of the basic principles of anatomy, physiology, pathology, and radiology involved. Some of these principles will be considered and their practical application illustrated.

Among the subjects to be discussed are:

1. The normal and abnormal hilum.
2. Roentgen signs of extrapleural disease.
3. Differential diagnosis of diaphragmatic elevation.
4. Anatomic variations in the interlobar septa.
5. The disrupted fissure.
6. Lobar collapse and expansion.
7. The "silhouette" sign.
8. The air bronchogram.

(This course continued Thursday, Course No. 30)

Course No. 24: 8:30-10 A.M., Thursday
**What the Chief Should Teach His Young
Braves About the Ethics and Economics of
Radiology**

W. EDWARD CHAMBERLAIN, M.D.
(Repetition of Course No. 14)

Course No. 25: 8:30-10 A.M., Thursday
**Design and Equipment of Radioisotope
Laboratories**

G. W. MORGAN
AEC Isotopes Division, Oak Ridge, Tenn.

Practical aspects of the design of and equipment for hospital radioisotope laboratories will be discussed, with suggested facilities for different programs utilizing different radioisotopes. Prototype laboratories and facilities will be presented for diagnostic and therapeutic programs (including those in which the radioisotopes are purchased in a form standardized ready for use), as well as for programs involving animal experimentation. Scale models of typical laboratories are displayed.

Course No. 26: 8:30-10 A.M., Thursday
Treatment of Cancer of the Lower Lip

JUAN A. del REGATO, M.D.
Colorado Springs, Colo.

Carcinomas of the lower lip are the most curable

form of cancer involving the oral cavity. These neoplasms can be controlled both by surgery and by radiotherapy.

Radiotherapy is more advantageously used in the moderately sized and advanced lesions, for it not only controls the primary lesion but gives the best esthetic results. Treatments need to be adapted to the circumstances of the case. Metastatic adenopathies from these lesions occur infrequently. The treatment of choice is surgery.

Course No. 27: 8:30-10 A.M., Thursday

**A Simplified System for the Development and
Control of Radiographic Quality**

JOHN H. FREED, M.D.
Denver, Colo.

A simplified method for developing an x-ray technic chart for any diagnostic equipment will be described and illustrated. The system, in its most simple form, requires only three radiographs of one body part and the application of a few simple rules and data.

Rules for modifying this x-ray technic chart to obtain short-scale optimum or long-scale contrast radiography while maintaining optimum radiographic density will be discussed, together with the advantages and disadvantages of various x-ray technics.

The system assists in routine daily instruction and supervision of x-ray technicians and provides maximum control of radiographic quality for a minimum of effort.

Course No. 28: 8:30-10 A.M., Thursday
Radium and Radioisotope Dosimetry

ELIZABETH F. FOCHT
Memorial Center, New York, N. Y.

The principles and technics of dosage calculations in the use of discrete sources for intracavitary or interstitial therapy are similar for all gamma-emitting isotopes. The fundamentals of distribution, amount, exposure, filter, and dose will be discussed for gamma-ray sources in general and then for particular variations of the more commonly employed elements, such as radium, radon, cobalt, gold, etc.

In some circumstances beta radiation may make a contribution, and it is necessary to evaluate the calculations in such cases.

Radiographic technics for determining spatial arrangement and gadgets for working out the dose in the case of non-rigid distributions will be reviewed. Models of some actual needle and seed distributions will be shown, and the method of making them outlined.

Course No. 29: 8:30-10 A.M., Thursday**Methods of Dosimetry and Methods of Clinical Utilization of Cobalt 60 by Interstitial, Intracavitary and Plaque Technics****ISADORE MESCHAN, M.D.**

Little Rock, Ark.

*assisted by***GILLIAM BROGDON, M.D., and NEIL CROW, M.D.**

University of Arkansas School of Medicine

The basic physical aspects of Cobalt 60 will be presented, largely in tabular form, as pertains to its interstitial, plaque, and intracavitary applications. Methods of clinical utilization will be described. The latter will include the presentation of exemplary problems from simple to highly specialized applications integrating with established Paterson-Parker, and Quimby principles.

The special problems and scope of Cobalt 60 as a radium substitute will be emphasized.

Course No. 30: 8:30-10 A.M., Thursday**Some Fundamentals in Chest Roentgen Interpretation****BENJAMIN FELSON, M.D.***(Continued from Wednesday, Course No. 23)***Course No. 31: 8:30-10 A.M., Friday****The Key Area (Attic-Aditus-Antrum) in the Chronic Mastoid****GILBERT R. OWEN, M.D.**

Los Angeles, Calif.

This presentation has been arranged for the consideration of technicians, internes and residents, and practitioners and specialists in both roentgenology and otology in the roentgen interpretation of the chronic mastoid, and ultimately for the consideration of the otologic clinician and surgeon in the evaluation thereof.

We have demonstrated successfully, we believe, that residents in otology and roentgenology can be taught those fundamentals of each other's specialties pertinent to their reciprocal requirements. This has been attained by combined courses for both groups in Roentgen Anatomy followed by interpretation of normal and abnormal x-ray films. This accomplished, upon request, the roentgenologist will project the anatomical variants and histopathologic manifestations into the necessary spatial relationships, and the two may then confer to mutual advantage.

The basic group of projections—the Law or Schüller, the Stenvers' and the Mayer, plus other accepted projections—all connote, in varying degree, distortion of our anatomical teachings. It is prob-

able that the greater the otologist's familiarity with the surgical-anatomical picture, the greater will be the problem of adjusting to such distortions.

That the otologist may more readily choose between the radical and modified-radical procedures, it seems desirable that the relatively early inflammatory, granulomatous, and resorptive factors be recognized prior to the incidence of the grossly destructive resorption and accompanying hearing loss of cholesteatosis. To this end, we will attempt to show the nearest possible replication of our anatomical memory-pattern of the attic-aditus-antral area (the key area).

This projection will be submitted, not as a modification or a substitute, but as an amplification of our x-ray diagnostic armamentarium.

Course No. 32: 8:30-10 A.M., Friday**Pediatric X-ray Diagnosis****RAYMOND R. LANIER, M.D.**

Denver, Colo.

A brief discussion of technic for obtaining satisfactory excretory pyelograms, cystograms, and urethrograms in infants and small children will precede the demonstration of normal variations and the more common congenital anomalies encountered. These will be followed by cases illustrating the effects of trauma to the urinary tract. The more common infections and their sequelae will be presented, and examples of the neoplasms most commonly encountered in childhood will complete the study.

Course No. 33: 8:30-10 A.M., Friday**Cerebral Angiography****HOWARD L. STEINBACH, M.D.**

San Francisco, Calif.

A brief discussion of the technics of cerebral angiography will be presented. The opaque media and their undesirable side-reactions will be reviewed. Roentgenograms will be presented demonstrating the normal anatomy and normal variations of the cerebral vessels, vascular occlusions, vascular malformations, and neoplasms.

Course No. 34: 8:30-10 A.M., Friday**Myelography****HAROLD O. PETERSON, M.D.**

St. Paul, Minn.

Pantopaque myelography will be discussed from the standpoint of technic, normal anatomy and variations, subdural and extradural injections, cord tumors, herniated disks, and miscellaneous conditions. Details of the best and simplest method of injecting and removing the Pantopaque with essentially no discomfort to the patient will be included.

From a diagnostic standpoint, the importance of recognizing normal variations and subdural injections will be stressed.

Cord tumors and herniated disks will be discussed in as much detail as time permits.

Course No. 35: 8:30-10 A.M., Friday

High-Energy Accelerators and Some of Their Medical Applications

GAIL ADAMS, Ph.D.

San Francisco, Calif.

The general characteristics of the common accelerators found in the energy range above 5 mev will be discussed. Radiations ordinarily produced by each will be mentioned together with areas of medical application, particularly cancer therapy. Some of the problems relating to the dosimetry and the relative biological effectiveness (RBE) of these radiations will be examined.

Course No. 36: 8:30-10 A.M., Friday

Examination of the Colon

HENRY C. CROZIER, M.D.

Los Angeles, Calif.

In this course there will be discussed in some detail the indications for examination of the colon, the various technics which may be employed, and the factors which influence a choice of one technic

or another. Films will be presented demonstrating the various pathological entities which may be discovered by this type of examination, and some time will be given to the discussion of utilization of the air-contrast study and the possibility of following such an examination by a conventional barium enema examination without inflicting two days loss of time on the patient. A special technic for examination of the colon by the air-contrast method which has been employed in a considerable number of cases will be demonstrated.

Course No. 37: 8:30-10 A.M., Friday

Control of Roentgenographic Diagnostic Procedures With Particular Reference to Film Processing

GEORGE C. HENNY, M.D.

Philadelphia, Penna.

The effects of focal-spot size, of shadow projection variables, and of the Potter-Bucky diaphragm are well known to most roentgenologists. From observation it appears that the factors of dark room control are less familiar. The cause of most poor roentgenograms is found in the handling of the film or its processing. Most artefacts are produced in the dark room. The details of good dark room procedure will be discussed with particular reference to a practical method to control the constancy of development.



ANNOUNCEMENTS AND BOOK REVIEWS

BLOOD COUNTS

Statement of
National Committee on Radiation Protection

An *ad hoc* committee of the National Committee on Radiation Protection was formed two years ago for the purpose of determining whether or not the use of blood count technic was necessary in the control of radiation exposure. The following statement has been prepared by the subcommittee and adopted by the National Committee:

"1. Provided that radiation monitoring of personnel, and where applicable of sites, is carried out by instruments (film badges, pocket meters, etc.) in all circumstances involving potential exposure to penetrating ionization radiations, blood counts should no longer be required as a *method of monitoring*.

"2. Blood counts as a part of pre-employment, interval, and terminal examinations are good medical practice—to be done at the discretion of the medical officer in charge—but not as a part of a monitoring service.

"3. Blood counts are a necessary part of the medical examination of anyone over-exposed to penetrating ionizing radiations."

CHICAGO ROENTGEN SOCIETY

Newly elected officers of the Chicago Roentgen Society are Elbert K. Lewis, M.D., President; Erich Uhlmann, M.D., Vice-President; R. Burns Lewis, M.D., 670 N. Michigan Ave., Chicago 11, Secretary-Treasurer.

GEORGIA RADIOLOGICAL SOCIETY

At a recent meeting of the Georgia Radiological Society, Dr. Franklin G. Eldridge, of Valdosta, was elected President; Dr. William C. Coles, of Atlanta, Vice-President; Dr. Herbert M. Olnick, 417 Persons Bldg., Macon, Secretary-Treasurer.

The next meeting of the Society will be held in November with the Florida Radiological Society.

MINNESOTA RADIOLOGICAL SOCIETY

The following officers were elected by the Minnesota Radiological Society at their recent meeting: President, Dr. Chauncey N. Borman, of Minneapolis; Vice-President, Dr. Harold O. Peterson, of St. Paul; Secretary-Treasurer, Dr. John R. Hodgson, Mayo Clinic, Rochester.

NASSAU (N. Y.) RADIOLOGICAL SOCIETY

Recently elected officers of the Nassau Radiological Society are: President, Samuel Herstone,

M.D.; Vice-President, Herbert Zatkin, M.D.; Treasurer, John Knapp, M.D.; Secretary, Alan E. Baum, M.D., Hicksville, N. Y. Dr. Frank Huber and Dr. James C. Barnett were elected to the Executive Committee.

PHILADELPHIA ROENTGEN RAY SOCIETY

The following were recently elected to office in the Philadelphia Roentgen Ray Society: Richard H. Chamberlain, M.D., President; Marston T. Woodruff, M.D., Vice-President; D. Alan Sampson, M.D., Treasurer; Herbert M. Stauffer, M.D., Temple University Hospital, 3401 N. Broad St., Philadelphia 40, Secretary.

OREGON RADIOLOGICAL SOCIETY

The officers of the Oregon Radiological Society for the ensuing year are: President, C. Todd Jessell, M.D., of Portland; President-Elect, Gregory B. Nichols, M.D., of Portland; Vice-President, Clay A. Racely, of Eugene; Secretary-Treasurer, Fred C. Shipps, M.D., 214 Medical-Dental Bldg., Portland 5. Dr. Woodson Bennett of Salem was elected to the Executive Committee.

CONTINUATION COURSE IN RADIOLOGY UNIVERSITY OF MINNESOTA

The University of Minnesota announces its annual Continuation Course in Radiology for Specialists to be held at the Center for Continuation Study on the University campus Nov. 9-13, 1954. Bone and Joint Diseases will be the subject of this year's course. Guest faculty will include Doctors C. Howard Hatcher, Professor of Orthopedic Surgery, University of Chicago School of Medicine; Paul C. Hodges, Professor, Department of Radiology, University of Chicago School of Medicine; John F. Holt, Professor, Department of Radiology, University of Michigan Medical School, Ann Arbor; G. S. Lodwick, Chief, Department of Radiology, Veterans Administration Hospital, and Clinical Assistant Professor, Department of Radiology, State University of Iowa College of Medicine, Iowa City; Edward B. D. Neuhauser, Associate Radiologist, Harvard Medical School, Boston; Isidore Snapper, Director of Medicine and Medical Education, Beth-El Hospital, Brooklyn, N. Y. The course will be presented under the direction of Dr. Leo G. Rigler, Professor and Head of the Department of Radiology. Other participants will include members of the faculty of the University of Minnesota Medical School and of the Mayo Foundation. Lodging and meal accommodations are available at the Center for Continuation Study.

CONFERENCE ON CANCERS OF THE DIGESTIVE TRACT

A round table conference on recent and changing concepts in the diagnosis and management of cancers of the digestive tract will be held, under the auspices of the Strasburger Memorial Medical Foundation, on Friday, Nov. 12, from 9:30 A.M. to 1 P.M., in the Auditorium of Memorial Center for Cancer and Allied Diseases, 444 East 68th Street, New York City. Participating in the discussion will be Dr. Thomas P. Almy, Dr. Alexander Brunschwig, Dr. W. Emory Burnett, Dr. Michael R. Deddish, Dr. John A. Evans, Dr. Sara M. Jordan, Dr. Samuel F. Marshall, Dr. Gordon P. McNeer, Dr. George T. Pack, Dr. Frederick S. Philips, Dr. Milton R. Porter, Dr. I. S. Ravdin, Dr. Robert S. Sherman, Dr. R. H. Sweet, and Dr. William L. Watson.

As seating capacity is limited, requests for reservations should be made before Nov. 5, to Office of the Assistant Clinical Director, Memorial Center, 444 East 68th Street, New York 21, N. Y.

SUITER LECTURE NEW YORK ACADEMY OF MEDICINE

The Suiter Lecture, established under the will of the late Dr. A. Walter Suiter, will be held on Nov. 4, at the New York Academy of Medicine. It will take the form of a symposium: "Cancer: What We Know Today." Participating speakers will be Harold F. Dorn, Ph.D., Bethesda, Md.; Harold L. Stewart, M.D., Bethesda, Md.; Lauren V. Ackerman, M.D., St. Louis, Mo.; Owen H. Wangenstein, M.D., Minneapolis, Minn.; Richard H. Chamberlain, M.D., Philadelphia, Penna.; Alfred Gellhorn, M.D., New York, N. Y.

MEDICAL RESEARCH FELLOWSHIPS

The Division of Medical Sciences of the National Research Council is accepting applications for post-doctoral research fellowships for 1955-56. These awards are designed to offer research experience for promising individuals who look forward to investigative careers, and not to provide practical experience in the clinical field. Ordinarily fellowships are not granted to persons over thirty-five years of age. The following programs are announced:

Fellowships in Cancer Research, available for study in all branches of the biological, chemical, and physical sciences and of clinical investigation applicable to the study of growth, typical or malignant.

British-American Exchange Fellowships in Cancer Research, offered to citizens of the United States for advanced study in Great Britain in specialized fields pertaining to the problem of cancer.

Fellowships in the Medical Sciences, in particular the basic medical sciences.

Fellowships in Tuberculosis, designed to promote the development of investigations in fields related to that disease.

Fellowships in Radiological Research: The Picker Foundation, which supports these fellowships, has expressed particular interest in candidates who propose to carry on research oriented toward the diagnostic aspects of radiology.

Applications for 1955-56 under any of these programs must be postmarked on or before Dec. 10, 1954. Fellowships are awarded in the late winter or early spring. Complete details and application blanks may be obtained from the Fellowship Office, National Research Council, 2101 Constitution Avenue, N. W., Washington 25, D. C.

JAMES PICKER FOUNDATION AWARDS IN RADIOLOGICAL RESEARCH

On behalf of the James Picker Foundation, the National Research Council announces the continued availability of funds in support of radiological research.

Grants-in-aid are designed to encourage research offering promise of improvement in radiological methods of diagnosis or treatment of disease. Applications for the fiscal year 1955-56 must be submitted on or before Nov. 30, 1954.

Grants for Scholars are a transitional form of support, designed to bridge the gap between the completion of fellowship training and the period when the young scientist has thoroughly demonstrated his competence as an independent investigator. A grant of \$6,000 per year will be made directly to the Scholar's institution as a contribution toward his support, or his research, or both. Initial grants are limited to one year, but renewal may be recommended. Applications for 1955-56 should be submitted by the institution on behalf of the candidate prior to Nov. 30, 1954.

Fellowships in Radiological Research, available under the program of the Foundation, are described in the preceding announcement.

Further details and application blanks may be obtained from the Division of Medical Sciences, National Research Council, 2101 Constitution Avenue, N. W., Washington 25, D. C.

The following grants and fellowships have been announced for 1954-55:

Grants in Radiological Research: Dr. Henry Doubilet, New York University College of Medicine, for continued work on the x-ray visualization of the biliary and pancreatic ducts; Dr. Jack Friedman, Mount Sinai Hospital, Minneapolis, for studies on the effect of emotion on the mucosal pattern of the small bowel; Dr. J. W. Grossman and Dr. J. L. Howarth, Lovelace Foundation for Medical Education and Research, Albuquerque, for development of technic for dose estimation, using a Cobalt-60 unit; Dr. George Jacobson and Dr. Donald C. Balfour, Jr., University of Southern California School of Medicine, for an investigation of the use of pharmacological agents in the radiologic diagnosis of gastrointestinal disease; Dr. Hilde Levi, Zoophysiological

Laboratory, University of Copenhagen, for continuation of her autoradiographic studies of alpha and soft beta emitters in animal tissue; *Dr. Gardner Middlebrook*, National Jewish Hospital, Denver, for continued pulmonary angiographic studies pre- and postresection in tuberculosis and simulating diseases; *Dr. Björn E. W. Nordenström*, Sabbatsberg Hospital, Stockholm, for continuation of his work on the development of a new principle for examination by x-ray of pulmonary vessels; *Dr. Henry P. Plenk*, University of Utah College of Medicine, for continued studies on the influence of drugs on radiation reaction; *Dr. William J. Tobin*, Georgetown University School of Medicine, for continued study of bone architecture.

Fellowships in Radiological Research: *Dr. Murray G. Smyth, Jr.*, for studies on the distribution and dosage of colloidal and particulate sources of radioactivity, under the guidance of Dr. R. H. Chamberlain at the University of Pennsylvania School of Medicine; *Dr. Kakarla Subbarao*, for an investigation of regional ileus as a roentgenological manifestation of disease, under the guidance of Dr. M. H. Poppel at Bellevue Hospital, New York.

GRANTS-IN-AID IN CANCER RESEARCH

Acting for the American Cancer Society, the Committee on Growth of the National Research Council is accepting applications for grants-in-aid for cancer research in the United States. Applications received before Oct. 1 will be considered during the winter and grants recommended at that time become effective on July 1, 1955.

The scope of the research program includes, in addition to clinical investigations on cancer, fundamental studies in the fields of cellular physiology, morphogenesis, genetics, virology, biochemistry, metabolism, nutrition, cytochemistry, physics, radiobiology, chemotherapy, endocrinology, and environmental cancer.

Application blanks and additional information may be obtained from the Executive Secretary, Committee on Growth, National Research Council, 2101 Constitution Avenue, N. W., Washington 25, D. C.

Books Received

Books received are acknowledged under this heading, and such notice may be regarded as recognition of the courtesy of the sender. Reviews will be published in the interest of our readers and as space permits.

THE MEDICAL ANNUAL. A YEAR BOOK OF TREATMENT AND PRACTITIONERS' INDEX. Editors: SIR HENRY TIDY, K.B.E., M.A., M.D. (Oxon), F.R.C.P., and R. MILNES WALKER, M.S. (Lond), F.R.C.S. A volume of 524 pages. Published by John Wright & Sons Ltd., Bristol, 1954.

ELEKTROMEDIZIN UND STRAHLENKUNDE. By DR. PHIL. WALTHER RUMP, Professor für medizinische Physik an der Universität Erlangen. Sonderband zur Strahlentherapie, Band 30. A volume of 200 pages, with 83 illustrations. Published by Urban & Schwarzenberg, München and Berlin, 1954.

FUNKTIONELLE RÖNTGENDIAGNOSTIK DER HALSWIRBELSÄULE. By Dr. C. BUETTI-BÄUML, Priv.-Dozent, Universitäts-Röntgeninstitut Basel. A volume of 160 pages, with 154 illustrations. Published by Georg Thieme Verlag, Stuttgart, 1954. Distributors in the United States and Canada, Intercontinental Medical Book Corp., New York, N. Y., Price DM 42.—

Book Reviews

PHYSICAL AND CHEMICAL ASPECTS OF BASIC MECHANISMS IN RADIOBIOLOGY. Proceedings of an Informal Conference Held at Highland Park, Ill., May 7-9, 1953. Edited by JOHN L. MAGEE, MARTIN D. KAMEN, and ROBERT L. PLATZMAN. Washington, D. C., National Research Council, 1953. A paper-bound volume of 146 pages. Price \$1.00.

This is the well edited transcript of an informal conference held in May 1953, in which 23 scientists participated, one of them a clinical radiologist (Hymer Friedell) and one physicist serving clinical radiology (G. Failla). It is informal indeed, and the give and take of information is revealing of the most admirable open-mindedness. The participants were exploring the minute pattern of absorption of radiant energy in biologic materials, bringing to bear information from all kinds of experiments, including ionization in gases; chemical reactions in water, organic liquids, liquid ammonia, and other liquefied gases; trapped ions in ice and in the glassy state of organic liquids at temperatures far below zero, and the time relations of scintillating substances, especially in liquid and solid solution. Also, continually referred to are the excited levels of the modern theory of radiation and absorption (spectroscopy).

The Conference was conducted in five sessions, each presided over by a different scientist with a different slant, who guided the discussion but made no great effort to hold back from the exploration of profitable bypaths. Platzman opened with Initial Energy Transfer, and continued with Energy Transfer from Secondary Electrons to Matter. Magee led the discussion on Mechanisms of Energy Degradation and Chemical Change, and Henry Linschitz (Syracuse University) that on Effects of Electronic Excitation. Kamen presided over the session on Radiation Chemical Effects in Radiobiology and did the summing up.

There is much of great background importance to radiation therapy. We have long been talking

about ion pairs and non-specific chemical action. It is a revelation to learn of the mechanisms for separation of the ions and the formation of active radicles (in water); of the difference between electrolytic ions always present in water and the nascent ions from irradiation; of the dominance of the lifetime of a given excited state (1 sec. , 10^{-6} sec. , or 10^{-13} sec.) related to the times required for transfer of energy (a few electron volts). There is plenty of evidence that different substances are affected in very different ways by radiation, *i.e.* that the breakage of different molecules goes in specific fashion and with greatly different efficiencies; also, that small amounts of impurities may change the channeling of the energy effective in markedly different ways. On many things the scientists failed to agree, and much time was given to exploring possibilities for critical experiments that need to be performed.

The reviewer found the matter difficult, but achieved easy reading by adopting the somewhat detached attitude of the sidewalk superintendent. Aghast at how little he understood, he felt better upon reading Kamen's remark "It is beginning to percolate," and later, concerning the treatment of ionization in water as similar to ionization in gas simply condensed by a factor of 10^3 : "It came as a revelation to me that there is some other way of thinking about it, and I suppose it did to most of the biologists here."

X-RAY SIEVE THERAPY IN CANCER. A CONNECTIVE TISSUE PROBLEM. By BENJAMIN JOLLES, M.D., D.M.R., Consultant Radiotherapist, Physician i/c Radiotherapy Department, General Hospital, Northampton; Formerly Duchess of Bedford Research Fellow in Medical Radiology, The Middlesex Hospital Medical School, London, etc. With a Foreword by SIDNEY RUSS, C.B.E., D.Sc., F. Inst. P., Professor Emeritus, Middlesex Hospital, Fellow of University College, London. A volume of 192 pages, with 51 illustrations. Published by Little, Brown & Co., Boston, 1953. Price \$6.00.

Dr. Benjamin Jolles, a recognized authority on radiotherapy, has for some time been interested in the grid or "sieve" method and is well qualified to write on the subject. His book is in three parts: the first deals with the role of connective tissue in the development and growth of cancer; the second concerns irradiated tissues and the surrounding structures, including indirect radiation effects; the third discusses the principles of the "sieve" and its therapeutic application.

The understandable manner in which the whole subject is presented and the emphasis upon meticulous preparation of the patient for treatment, the importance of daily observation, and other factors in proper radiotherapy, make this a book well worth reading by all radiotherapists even though they may not be concerned with the "sieve."

As presented here, the method appears worthy of more attention than it has received in this country. As a guide to its employment, this book is highly recommended.

AN ATLAS OF CONGENITAL ANOMALIES OF THE HEART AND GREAT VESSELS. By JESSE E. EDWARDS, B.S., M.D., THOMAS J. DRY, B.A., M.A., M.B., Ch.B., M.S., ROBERT L. PARKER, M.D., M.S., F.A.C.P., HOWARD B. BURCHELL, M.D., Ph.D., EARL H. WOOD, M.D., Ph.D., and ARTHUR H. BULBULIAN, M.S., D.D.S., of the Mayo Clinic and Mayo Foundation. A volume of 203 pages, with 272 figures, of which 34 are in color. Published by Charles C Thomas, Springfield, Ill., 1954. Price \$13.50.

This Atlas, though it was begun as a second edition of the smaller volume on *Congenital Anomalies of the Heart and Great Vessels* by Dry *et al.*, published in 1948, includes so much new material that it can well be regarded as a different work. It compresses a remarkable amount of information about congenital heart disease into the space of approximately 200 pages. All of the common abnormalities are considered, and many of the uncommon ones. The typical presentation for a given anomaly consists of a diagram of the circulation, one or more photographs of an anatomic specimen, one or more color photographs of models prepared from the specimen, electrocardiograms, one or more films of the chest, a brief clinical history, and a summary of the principal clinical features.

The book is beautifully printed and can be wholeheartedly recommended, though from the standpoint of the radiologist, the reproduction of additional projections of the chest and angiocardiograms would have been desirable. Among minor criticisms which can be offered are the relatively sketchy treatment of Lutembacher's complex and the omission of any consideration of glycogen storage disease.

ADVANCES IN CANCER RESEARCH. Edited by JESSE P. GREENSTEIN, National Cancer Institute, U. S. Public Health Service, Bethesda, Md., and ALEXANDER HADDOW, Chester Beatty Research Institute, Royal Cancer Hospital, London, England. Vol. II. A volume of 530 pages, with numerous graphs and tables. Published by Academic Press, Inc., New York, N. Y., 1954. Price \$11.00.

The first volume in a projected series designed to follow the current course of cancer research has been reviewed earlier in these columns (*Radiology* 61: 951, 1953). This second volume should be of even more interest to radiologists, particularly the chapters on "Ionizing Radiations and Cancer," by Austin M. Brues, and on "Some Aspects of the Clinical Use of Nitrogen Mustards," by Calvin T. Klopp and Jeanne C. Bateman. Carcinogenesis is again the subject of primary concern, and studies on

carcinogens—chemicals, viruses, and radiation—and genetic, hormonal, and dietary factors influencing their effectiveness are recorded. One chapter deals with the preservation of tumors in the frozen state. Not only are the United States and Great Britain represented, but there are contributions from Australia, France, and Israel.

The extensive bibliographies at the end of each chapter should be helpful to workers in the research field and to others interested in further reading on the subjects covered. It might have been worth the few extra pages required to have included the titles of the articles.

RÖNTGENANATOMISCHE GRUNDLAGEN DER LUNGENUNTERSUCHUNG. By F. KOVÁTS, JR., Primarius des Tuberkulose-Forschungsinstitutes, and Z. ZSEBÖK, Dozent an der II. Chir. Universitätsklinik. A volume of 288 pages, with 311 illustrations. Published by Akadémiai Kiado, Budapest, 1953.

In this work the authors have furnished us with a most comprehensive and accurate account of the anatomical basis for roentgenography of the lungs. The method of examination used for many of the anatomical studies is of interest. The lungs of the cadaver were first hardened by pouring formalin into the trachea so as to preserve their original form. Then routine as well as planigraphic films in layers of 1 cm. apart were taken. The arterial system was next injected with red-colored and the venous system with blue-colored lead suspensions. Again ordinary and planigraphic films were taken. Finally, the lung specimen itself was cut into layers 1 cm. thick and the individual sections radiographed. A comparison of the films with the anatomical specimen, allowed an accurate identification of every shadow on the roentgenograms, as well as an analysis of the summation shadow of the standard chest film into its components, as shown on the films of the various layers.

The bronchial system is described and analyzed in great detail. The segmental division of the lungs and their localized pathologic involvement are demonstrated by excellent roentgenograms. The

technic of bronchography and arteriography is explained.

The text is generously illustrated with excellent photographs of anatomical specimens and many roentgenograms, often supplemented by explanatory schematic drawings. The book is not only valuable for the radiologist but particularly for the chest surgeon, since special attention is paid to the topographic anatomy. It is the result of many years of careful observation in this special field and represents an enormous amount of painstaking work.

TRAITÉ DES CARDIOPATHIES CONGÉNITALES. By HEIM DE BALSAC, C. MÉTIANU, M. DURAND, CH. DUBOST, M. ALLARY, N. DU BOUCHET, A.-M. EMAM-ZADÉ, J.-E. ESCALLE, B. LATSCHA, J. LE BRIGAND, and N. OECONOMOS, under the direction of E. DONZELOT, Professeur de Clinique Cardiologique à la Faculté de Médecine de Paris, Médecin de l'Hôpital Broussais, and F. D'ALLAINES, Professeur de Clinique Chirurgicale à la Faculté de Paris: Chirurgien de l'Hôpital Broussais. A volume of 1116 pages, with 1155 illustrations. Published by Masson et Cie, Paris, 1954. Price 13,800 francs.

This extensive monograph covers in detail the various forms of congenital cardiac disease in their anatomic, physiologic, pathologic, and clinical aspects. It includes a large number of reproductions of roentgenograms of congenital heart lesions, as well as schematic drawings to indicate the variations of some of the anomalies. A certain amount of space is devoted to electrocardiographic changes and to changes noted on cardiac catheterization and angiocardiology. Many of the standard surgical procedures are discussed, although some of the more recent developments in this field have been omitted. This is understandable, since in the case of any extensive treatise covering so wide a field there are bound to be developments occurring between the time of writing and publication.

This work is one of the most comprehensive single texts in the field of congenital cardiac disease. For anyone who reads French it is well worth while. An English translation would be highly desirable.

RADIOLOGICAL SOCIETIES: SECRETARIES AND MEETING DATES

Editor's Note: Secretaries of state and local radiological societies are requested to co-operate in keeping this section up-to-date by notifying the editor promptly of changes in officers and meeting dates.

RADIOLOGICAL SOCIETY OF NORTH AMERICA. *Secretary-Treasurer,* Donald S. Childs, M.D., 713 E. Genesee St., Syracuse 2, N. Y.

AMERICAN RADIUM SOCIETY. *Secretary,* Robert E. Fricke, M.D., Mayo Clinic, Rochester, Minn.

AMERICAN ROENTGEN RAY SOCIETY. *Secretary,* Barton R. Young, M.D., Germantown Hospital, Philadelphia 44, Penna.

AMERICAN COLLEGE OF RADIOLOGY. *Exec. Secretary,* William C. Stronach, 20 N. Wacker Dr., Chicago 6.

SECTION ON RADIOLOGY, A. M. A. *Secretary,* Paul C. Hodges, M.D., 950 East 59th St., Chicago 37.

Alabama

ALABAMA RADIOLOGICAL SOCIETY. *Secretary-Treasurer,* J. A. Meadows, Jr., M.D., Medical Arts Bldg., Birmingham 5.

Arizona

ARIZONA RADIOLOGICAL SOCIETY. *Secretary-Treasurer,* R. Lee Foster, M.D., 507 Professional Bldg., Phoenix. Annual meeting with State Medical Association; interim meeting in December.

Arkansas

ARKANSAS RADIOLOGICAL SOCIETY. *Secretary,* Joe A. Norton, M.D., 843 Donaghey Bldg., Little Rock. Meets every three months and at meeting of State Medical Society.

California

CALIFORNIA MEDICAL ASSOCIATION, SECTION ON RADIOLOGY. *Secretary,* H. R. Morris, M.D., 1027 D St., San Bernardino.

EAST BAY ROENTGEN SOCIETY. *Secretary,* Dan Tucker, M.D., 434 30th St., Oakland 9. Meets monthly, first Thursday, at Peralta Hospital.

LOS ANGELES RADIOLOGICAL SOCIETY. *Secretary,* Oscar Harvey, M.D., 3741 Stocker St., Los Angeles 8. Meets monthly, second Wednesday, Los Angeles County Medical Association Bldg.

NORTHERN CALIFORNIA RADIOLOGICAL CLUB. *Secretary,* H. B. Stewart, Jr., M.D., 2920 Capitol Ave., Sacramento. Meets last Monday of each month, September to May.

PACIFIC ROENTGEN SOCIETY. *Secretary,* L. Henry Garland, M.D., 450 Sutter St., San Francisco 8. Meets annually at time of California State Medical Association convention.

RADIOLOGICAL SOCIETY OF SOUTHERN CALIFORNIA. *Secretary-Treasurer,* George Jacobson, M.D., Box 146, 1200 N. State St., Los Angeles 33.

SAN DIEGO RADIOLOGICAL SOCIETY. *Secretary,* C. W. Bruner, M.D., 2456 Fourth Ave., San Diego 1. Meets first Wednesday of each month.

SAN FRANCISCO RADIOLOGICAL SOCIETY. *Secretary,* I. J. Miller, M.D., 2680 Ocean Ave., San Francisco 27. Meets quarterly, at the University Club.

SOUTH BAY RADIOLOGICAL SOCIETY. *Secretary,* Herbert R. Berman, M.D., 309 St. Claire Bldg., San Jose. Meets monthly, second Wednesday.

X-RAY STUDY CLUB OF SAN FRANCISCO. *Secretary,* Wm. W. Saunders, M.D., VA Hospital, San Francisco 21. Meets third Thursday at 7:45, Lane Hall, Stanford University Hospital.

Colorado

COLORADO RADIOLOGICAL SOCIETY. *Secretary,* Parker Allen, M.D., Children's Hospital, Denver. Meets monthly, third Friday, at University of Colorado Medical Center or Denver Athletic Club.

Connecticut

CONNECTICUT STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY. *Secretary-Treasurer,* William A. Goodrich, M.D., 85 Jefferson St., Hartford 14. Meets bimonthly, second Wednesday.

District of Columbia

RADIOLOGICAL SECTION, DISTRICT OF COLUMBIA MEDICAL SOCIETY. *Secretary,* John A. Long, M.D., 1801 K St., N.W., Washington 6. Meets third Wednesday, January, March, May, and October, at 8:00 P.M., in Medical Society Library.

Florida

FLORIDA RADIOLOGICAL SOCIETY. *Secretary-Treasurer,* James T. Shelden, M.D., Box 1021, Lakeland. Meets in April and in October.

GREATER MIAMI RADIOLOGICAL SOCIETY. *Secretary-Treasurer,* Richard D. Shapiro, M.D., 541 Lincoln Road, Miami Beach. Meets monthly, third Wednesday, 8:00 P.M.

NORTH FLORIDA RADIOLOGICAL SOCIETY. *Secretary-Treasurer,* Ivan Isaacs, M.D., 1645 San Marco Blvd., Jacksonville 7. Meets quarterly, March, June, September, and December.

Georgia

ATLANTA RADIOLOGICAL SOCIETY. *Secretary-Treasurer,* Albert A. Rayle, Jr., M.D., 490 Peachtree St. Meets second Friday, September to May.

GEORGIA RADIOLOGICAL SOCIETY. *Secretary-Treasurer,* Herbert M. Olnick, M.D., 417 Persons Bldg., Macon, Ga. Meets in November and at the annual meeting of the State Medical Association.

RICHMOND COUNTY RADIOLOGICAL SOCIETY. *Secretary,* Wm. F. Hamilton, Jr., M.D., University Hospital, Augusta. Meets first Thursday of each month.

Hawaii

RADIOLOGICAL SOCIETY OF HAWAII. *Secretary, H. C. Chang, M.D., 1282 Emma St., Honolulu 13. Meets third Monday of each month.*

Illinois

CHICAGO ROENTGEN SOCIETY. *Secretary, R. Burns Lewis, M.D., 670 N. Michigan Ave., Chicago 11. Meets at the University Club, second Thursday of October, November, January, February, March, and April at 8:00 P.M.*

ILLINOIS RADIOLOGICAL SOCIETY. *Secretary-Treasurer, Stephen L. Casper, M.D., Physicians and Surgeons Clinic, Quincy.*

ILLINOIS STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY. *Secretary, George E. Irwin, Jr., M.D., 427 N. Main St., Bloomington.*

Indiana

INDIANA ROENTGEN SOCIETY. *Secretary-Treasurer, John A. Robb, M.D., 238 Hume-Mansur Bldg., Indianapolis 4. Meets twice a year, first Sunday in May and during fall meeting of State Medical Association.*

TRI-STATE RADIOLOGICAL SOCIETY (Southern Indiana, Northwestern Kentucky, Southeastern Illinois). *Secretary-Treasurer, Stephen N. Tager, M.D., 219 Walnut St., Evansville 9, Ind. Meets last Wednesday, October, January, March, and May, 8:00 P.M., at the Elks' Club, Evansville, Ind.*

Iowa

IOWA RADIOLOGICAL SOCIETY. *Secretary, James T. McMillan, M.D., 1104 Bankers Trust Bldg., Des Moines. Meets during annual session of State Medical Society, and in the Fall.*

Kansas

KANSAS RADIOLOGICAL SOCIETY. *Secretary-Treasurer, A. M. Cherner, M.D., Hays, Kansas. Meets in the Spring with the State Medical Society and in the Winter on call.*

Kentucky

KENTUCKY RADIOLOGICAL SOCIETY. *Secretary, David Shapiro, M.D., Veterans Administration Hospital, Louisville 6. Meets monthly, second Friday, at Seelbach Hotel, Louisville.*

Louisiana

ORLEANS PARISH RADIOLOGICAL SOCIETY. *Secretary, Joseph V. Schlosser, M.D., Charity Hospital of Louisiana, New Orleans 13. Meets second Tuesday of each month.*

RADIOLOGICAL SOCIETY OF LOUISIANA. *Secretary-Treasurer, J. T. Brierre, M.D., 700 Audubon Bldg., New Orleans.*

SHREVEPORT RADIOLOGICAL CLUB. *Secretary, W. R. Harwell, M.D., 608 Travis St. Meets monthly September to May, third Wednesday.*

Maine

MAINE RADIOLOGICAL SOCIETY. *Secretary-Treasurer, Jack Spencer, M.D., Maine General Hospital, Portland 4. Meets three times a year—Spring, Summer, and Fall.*

Maryland

BALTIMORE CITY MEDICAL SOCIETY, RADIOLOGICAL SECTION. *Secretary-Treasurer, Paul W. Roman, M.D., 1810 Eutaw Place, Baltimore 17. Meets third Tuesday, September to May.*

MARYLAND RADIOLOGICAL SOCIETY. *Secretary-Treasurer, Paul W. Roman, M.D., 1810 Eutaw Place, Baltimore 17.*

Michigan

DETROIT X-RAY AND RADIUM SOCIETY. *Secretary, E. F. Lang, M.D., Harper Hospital, Detroit 1. Meets first Thursday, October to May, at Wayne County Medical Society club rooms.*

Minnesota

MINNESOTA RADIOLOGICAL SOCIETY. *Secretary, John R. Hodgson, M.D., The Mayo Clinic, Rochester. Meets in Spring and Fall and at annual meeting of State Medical Association.*

Mississippi

MISSISSIPPI RADIOLOGICAL SOCIETY. *Secretary-Treasurer, John W. Evans, M.D., 117 N. President St., Jackson, Miss. Meets monthly, on third Tuesday, at 6:30 P.M., at the Rotisserie Restaurant, Jackson.*

Missouri

RADIOLOGICAL SOCIETY OF GREATER KANSAS CITY. *Secretary, James E. McConchie, M.D., First National Bank Bldg., Independence, Mo. Meets last Friday of each month.*

ST. LOUIS SOCIETY OF RADIOLOGISTS. *Secretary, Wm. B. Seaman, M.D., 510 South Kingshighway, St. Louis 10. Meets on fourth Wednesday, October to May.*

Montana

MONTANA RADIOLOGICAL SOCIETY. *Secretary, Grant P. Raitt, M.D., 413 Medical Arts Bldg., Billings. Meets annually.*

Nebraska

NEBRASKA RADIOLOGICAL SOCIETY. *Secretary-Treasurer, James F. Kelly, Jr., M.D., 816 Medical Arts Bldg., Omaha. Meets third Wednesday of each month at 6 P.M. in Omaha or Lincoln.*

New England

CONNECTICUT VALLEY RADIOLOGICAL SOCIETY. *Secretary, B. Bruce Alicandri, M.D., 20 Maple St., Springfield, Mass. Meets second Friday of October and April.*

NEW ENGLAND ROENTGEN RAY SOCIETY. *Secretary, Stanley M. Wyman, M.D., Massachusetts General Hospital, Boston 14. Meets monthly on third Friday, at the Harvard Club, Boston.*

New Hampshire

NEW HAMPSHIRE ROENTGEN SOCIETY. *Secretary,* Albert C. Johnston, M.D., 127 Washington St., Keene.

New Jersey

RADIOLOGICAL SOCIETY OF NEW JERSEY. *Secretary,* Carye-Belle Henle, M.D., 195 N. 7th St., Newark. Meets at Atlantic City at time of State Medical Society and midwinter in Elizabeth.

New York

BUFFALO RADIOLOGICAL SOCIETY. *Secretary-Treasurer,* Mario C. Gian, M.D., 610 Niagara St., Buffalo 1. Meets second Monday, October to May.

CENTRAL NEW YORK ROENTGEN SOCIETY. *Secretary,* Dwight V. Needham, M.D., 608 E. Genesee St., Syracuse 2. Meets in January, May, and October.

KINGS COUNTY RADIOLOGICAL SOCIETY. *Secretary,* Solomon Maranov, M.D., 1450 51st St., Brooklyn 19. Meets fourth Thursday, October to April (except December), at 9:00 P.M., Kings County Medical Bldg.

NASSAU RADIOLOGICAL SOCIETY. *Secretary,* Alan E. Baum, M.D., Hicksville, N. Y. Meets second Tuesday, February, April, June, October, and December.

NEW YORK ROENTGEN SOCIETY. *Secretary,* Sidney Rubinfeld, M.D., 477 First Ave., New York 16.

NORTHEASTERN NEW YORK RADIOLOGICAL SOCIETY. *Secretary-Treasurer,* Donald H. Baxter, M.D., Albany Hospital, Albany. Meets in the capital area second Wednesday, October, November, March, and April. Annual meeting in May or June.

RADIOLOGICAL SOCIETY OF NEW YORK STATE. *Secretary-Treasurer,* Mario C. Gian, M.D., 610 Niagara St., Buffalo. Meets annually with the State Medical Society.

ROCHESTER ROENTGEN-RAY SOCIETY. *Secretary-Treasurer,* Henry H. Forsyth, Jr., M.D., 40 Meigs St., Rochester 7. Meets at Strong Memorial Hospital, 8:15 P.M., last Monday of each month, September through May.

WESTCHESTER RADIOLOGICAL SOCIETY. *Secretary-Treasurer,* Maynard G. Priestman, M.D., New Rochelle Hospital, New Rochelle, N. Y. Meets third Tuesday of January and October and at other times as announced.

North Carolina

RADIOLOGICAL SOCIETY OF NORTH CAROLINA. *Secretary,* Waldemar C. A. Sternbergh, M.D., 1400 Scott Ave., Charlotte 2. Meets in April and October.

North Dakota

NORTH DAKOTA RADIOLOGICAL SOCIETY. *Secretary-Treasurer,* H. Milton Berg, M.D., Quain & Ramstad Clinic, Bismarck. Meets in the Spring with State Medical Association; in Fall or Winter on call.

Ohio

OHIO STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer,* M. M. Thompson, Jr., M.D., 316 Michigan St., Toledo.

CENTRAL OHIO RADIOLOGICAL SOCIETY. *Secretary-Treasurer,* Howard W. Bangs, 1381 West Sixth Ave., Columbus 12. Meets second Thursday, October, December, February, April, and June, 6:30 P.M., Columbus Athletic Club, Columbus.

CLEVELAND RADIOLOGICAL SOCIETY. *Secretary-Treasurer,* Mortimer Lubert, M.D., Heights Medical Center Bldg., Cleveland Heights 6. Meets at 6:45 P.M. on fourth Monday, October to April, inclusive.

GREATER CINCINNATI RADIOLOGICAL SOCIETY. *Secretary-Treasurer,* Chapin Hawley, M.D., 927 Carew Tower, Cincinnati 2. Meets first Monday of each month, September to June, at Cincinnati General Hospital.

MIAMI VALLEY RADIOLOGICAL SOCIETY. *Secretary,* W. S. Koller, M.D., 60 Wyoming St., Dayton. Meets monthly, second Friday.

Oklahoma

OKLAHOMA STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer,* John R. Danstrom, M.D., Medical Arts Bldg., Oklahoma City.

Oregon

OREGON RADIOLOGICAL SOCIETY. *Secretary-Treasurer,* Fred C. Shippy, M.D., 214 Medical-Dental Bldg., Portland 5. Meets monthly, second Wednesday, October to June, at 8:00 P.M., University Club, Portland.

Pacific Northwest

PACIFIC NORTHWEST RADIOLOGICAL SOCIETY. *Secretary-Treasurer,* J. Richard Raines, M.D., 214 Medical-Dental Bldg., Portland 5, Ore. Meets annually in May.

Pennsylvania

PENNSYLVANIA RADIOLOGICAL SOCIETY. *Secretary-Treasurer,* James M. Converse, M.D., 416 Pine St., Williamsport 8. Meets annually.

PHILADELPHIA ROENTGEN RAY SOCIETY. *Secretary,* Herbert M. Stauffer, M.D., Temple University Hospital, Philadelphia 40. Meets first Thursday of each month at 5:00 P.M., from October to May, in Thompson Hall, College of Physicians.

PITTSBURGH ROENTGEN SOCIETY. *Secretary-Treasurer,* Donald H. Rice, M.D., 4800 Friendship Ave., Pittsburgh 24. Meets monthly, second Wednesday, at 6:30 P.M., October to May, at the Hotel Roosevelt.

Rocky Mountain States

ROCKY MOUNTAIN RADIOLOGICAL SOCIETY. *Secretary-Treasurer,* John H. Freed, M.D., 4200 East Ninth Ave., Denver 7, Colo.

South Carolina

SOUTH CAROLINA RADIOLOGICAL SOCIETY. *Secretary-Treasurer,* William A. Klauber, M.D., Self Memorial Hospital, Greenwood. Meets with State Medical Association in May.

South Dakota

RADIOLOGICAL SOCIETY OF SOUTH DAKOTA. *Secretary-Treasurer*, Donald J. Peik, M.D., 303 S. Minnesota Ave., Sioux Falls. Meets during annual meeting of State Medical Society.

Tennessee

MEMPHIS ROENTGEN CLUB. *Secretary*, Harvey Thompson, M.D., 899 Madison Ave. Meets first Monday of each month at John Gaston Hospital.

TENNESSEE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, George K. Henshall, M.D., 311 Medical Arts Bldg., Chattanooga 3. Meets annually with State Medical Society in April.

Texas

DALLAS-FORT WORTH RADIOLOGICAL CLUB. *Secretary*, Otto H. Grunow, M.D., 650 Fifth Ave., Fort Worth 4, Texas. Meets monthly, third Monday, 6:30 P.M., at the Greater Fort Worth International Airport.

HOUSTON RADIOLOGICAL SOCIETY. *Secretary*, Harry Fishbein, M.D., 324 Medical Arts Bldg., Houston 2.

SAN ANTONIO-MILITARY RADIOLOGICAL SOCIETY. *Secretary*, Hugo F. Elmendorf, Jr., M.D., 730 Medical Arts Building, San Antonio 5, Texas. Meets at Brook Army Medical Center, the first Monday of each month.

TEXAS RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, R. P. O'Bannon, M.D., 650 Fifth Ave., Fort Worth. Next meeting Jan. 29-30, 1954, Dallas.

Utah

UTAH STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Angus K. Wilson, M.D., 343 S. Main St., Salt Lake City 1. Meets third Wednesday, January, March, May, September, November.

Virginia

VIRGINIA RADIOLOGICAL SOCIETY. *Secretary*, P. B. Parsons, M.D., 1308 Manteo St., Norfolk 7.

Washington

WASHINGTON STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Eva L. Gilbertson, M.D., 1317 Marion St., Seattle 4. Meets fourth Monday, September through May, at 610 Pine St., Seattle.

West Virginia

WEST VIRGINIA RADIOLOGICAL SOCIETY. *Secretary*, W. Paul Elkin, 515-519, Medical Arts Bldg., Charleston. Meets concurrently with annual meeting of State Medical Society, and at other times as arranged by Program Committee.

Wisconsin

MILWAUKEE ROENTGEN RAY SOCIETY. *Secretary-Treasurer*, Jerome L. Marks, M.D., 161 W. Wisconsin Ave., Milwaukee 1. Meets monthly on fourth Monday at the University Club.

SECTION ON RADIOLOGY, STATE MEDICAL SOCIETY OF WISCONSIN. *Secretary*, Abraham Melamed, M.D., 425 E. Wisconsin Ave., Milwaukee 2. Meets in October with State Medical Society.

UNIVERSITY OF WISCONSIN RADIOLOGICAL CONFERENCE. Meets first and third Thursday at 4 P.M., September to May, Service Memorial Institute.

WISCONSIN RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, W. W. Moir, M.D., Sheboygan Memorial Hospital, Sheboygan.

Puerto Rico

ASOCIACIÓN PUERTORRIQUEÑA DE RADIOLOGÍA. *Secretary*, Rafael A. Blanes, M.D., Box 9724 Santurce, Puerto Rico.

CANADA

CANADIAN ASSOCIATION OF RADIOLOGISTS. *Honorary Secretary-Treasurer*, D. L. McRae, M.D., *Assoc. Hon. Secretary-Treasurer*, Guillaume Gill, M.D., *Central Office*, 1555 Summerhill Ave., Montreal 25, Quebec. Meets in January and June.

LA SOCIÉTÉ CANADIENNE-FRANÇAISE D'ELECTRO-RADIOLOGIE MÉDICALES. *General Secretary*, Is Ivan Vallée, M.D., Hôpital Saint-Luc, 1058 rue St-Denis, Montreal 18. Meets third Saturday of each month.

L'ASSOCIATION DES RADIOLOGISTES DE LA PROVINCE DE QUEBEC. *ASSOCIATION OF RADIOLOGISTS OF THE PROVINCE OF QUEBEC.* *Secretary*, Jean-Pierre Jean, M.D., 4039 Tupper St., Westmount, Que. Meets four times a year.

CUBA

SOCIEDAD DE RADIOLOGÍA Y FISIOTERAPIA DE CUBA. *Secretary*, Dr. Rafael Gómez Zaldivar. Offices in Hospital Mercedes, Havana. Meets monthly.

MEXICO

SOCIEDAD MEXICANA DE RADIOLOGÍA. A. C. *Headquarters*, Calle del Oro, Num. 15, Mexico 7, D. F. *Secretary General*, Dr. Eugenio Toussaint. Meets first Monday of each month.

PANAMA

SOCIEDAD RADIOLÓGICA PANAMEÑA. *Secretary-Editor*, Luis Arrieta Sánchez, M.D., Apartado No. 86, Panama, R. de P.

ABSTRACTS OF CURRENT LITERATURE

ROENTGEN DIAGNOSIS

The Head and Neck

- ROWBOTHAM, G. F., ET AL. Technique and the Dangers of Cerebral Angiography..... 440
- SEAMAN, WILLIAM B., AND SCHWARTZ, HENRY G. Cerebral Arteriography with Sodium Acetizoate (Urokon Sodium) 30%..... 440
- STERN, W. EUGENE. Studies of Pressures in the Carotid Artery of Patients Undergoing Cerebral Angiography..... 440
- NORLÉN, GÖSTA, AND BARNUM, ALEC S. Surgical Treatment of Aneurysms of the Anterior Communicating Artery..... 440
- JOHNSON, LEIGHTON F., AND STRONG, M. STUART. Teratoma of the Larynx..... 441

The Chest

- WERTHEMANN, A. Pulmonary Lesions from Bronchography with Joduron B on the Basis of Empiric and Experimental Observations..... 441
- KATZ, SOL, ET AL. Bronchography with a Water-Soluble Contrast Medium (Umbradil)..... 441
- ASCH, MARTIN. Acute Iodism Following Use of Chloriodized Oil (Iodochlorol) in Bronchography. Report of a Case..... 441
- FISCHER, ERNST J. The Value of Bronchography as a Special Diagnostic Procedure in Pulmonary Tuberculosis..... 442
- MARK, G. Oblique Tomography and Its Significance for Localization of Pulmonary Disease..... 442
- OLSON, DONALD E., ET AL. Bronchial Disease in Lungs Resected for Pulmonary Tuberculosis..... 442
- SPITZ, LEON J., AND SCHWARTZ, BENJAMIN. Histoplasmosis in Non-Endemic Regions..... 443
- LIESS, GÜNTHER. An Important Sign for the Roentgenographic Diagnosis of Chronic Lung Abscesses..... 443
- JOHNS, WILLIAM A. Localized Pulmonary Hypertrophic Emphysema..... 443
- MISCALL, LAURENCE, AND DUFFY, ROBERT W. Surgical Treatment of Bullous Emphysema. Contributions of Angiocardiography..... 443
- GOMBERT, H. J. Rare Causes or Forms of Intermittent and Constant Atelectasis..... 444
- DUNNER, LASAR, ET AL. Occupational Lung Damage in Ships' Repairers..... 444
- FINBY, NATHANIEL, AND STEINBERG, ISRAEL. "Primary" Undifferentiated Carcinoma in the Mediastinum. Report of Two Cases with Angiocardiographic and Pathologic Findings..... 444

The Cardiovascular System

- VAN EPPS, EUGENE F. A Symposium on Thoracic Cardiovascular Surgery at the State University of Iowa. II. Roentgenologic Evaluation..... 444
- DOTTER, CHARLES T., ET AL. Tricuspid Insuffi-

- ciency. Observations Based on Angiocardiography and Cardiac Catheterization in Twelve Patients..... 445
- TAGUINI, ALBERTO C., ET AL. Mitral Stenosis and Cor Pulmonale..... 445
- RAWSON, FREEMAN L., JR., AND DOERNER, ALEXANDER A. Functional Cor Triloculare..... 445
- STEINBERG, ISRAEL, ET AL. Myxoma of the Heart. Roentgen Diagnosis During Life in Three Cases..... 445
- STEINBERG, ISRAEL, ET AL. Persistence of Left Superior Vena Cava..... 446
- AURIG, G., AND SÜSSE, H.-J. Aneurysm of the Thoracic Aorta and the Possibilities of Its Demonstration..... 446
- WYLIE, EDWIN J., AND GARDNER, RICHARD E. Peripheral Arteriosclerosis. Present Concepts of Management..... 446
- BOYD, A. M., ET AL. The Technic and Interpretation of Lower Limb Phlebography..... 446

The Digestive System

- ALBOT, GUY, ET AL. Graduated Clinical Pre-detection of Digestive Tumors. Initial Results of the First Systematic Detection Center..... 447
- WARE, GEORGE W., AND CONRAD, HAROLD A. Thoracic Duplication of Alimentary Tract..... 447
- SMOOT, J. L. Adenocarcinoma and Leiomyosarcoma Occurring in the Same Stomach..... 447
- FRIEDMAN, A. I., ET AL. Ileocejunitis Involving the Entire Small Bowel..... 447
- SLEISENGER, MARVIN H., ET AL. The Sprue Syndrome Secondary to Lymphoma of the Small Bowel..... 448
- THIERS, ET AL. Radiology of the Small Intestine in the Dermatoses..... 448
- GLASS, BERT A., AND ABRAMSON, PAUL D. Volvulus of Cecum Due to Lithopedion..... 448
- KITCHEN, WILLIAM M. Roentgenologic Examination of the Bleeding Bowel..... 448
- HARRIS, J. WADE. Polyps of the Rectum and Colon in Children..... 449
- EKENGREN, KRISTINA, AND SNELLMAN, BJÖRN. Roentgen Appearances in Mechanical Rectal Constipation..... 449
- DOLAN, H. S., AND HOPKIRK, J. F. Acute Pancreatitis..... 449
- GOLDENBERG, IRA S. Carcinoma of the Biliary Tract..... 450
- HOLOUBEK, J. E., ET AL. Evaluation of Pseudoalbuminuria Following Cholecystography in Seventy-six Cases..... 450

The Musculoskeletal System

- LATIMER, F. R., ET AL. Osteitis Deformans with Spinal Cord Compression. Report of Three Cases..... 450

- COHEN, JONATHAN, AND DIAMOND, ISRAEL. Leontiasis Ossea, Slipped Epiphyses, and Granulosa Cell Tumor of Testis with Renal Disease. Report of a Case with Autopsy Findings. . . . 451
- GARCÍA GARCÍA, M. L. A Case of Klippel-Trenaunay Syndrome. . . . 451
- ASTLEY, R. Multiple Metaphyseal Fractures in Small Children. (Metaphyseal Fragility of Bone). . . . 451
- PAULSON, E. C., AND STERRIE, NORMAN. Cleidocranial Dysostosis. . . . 451
- BINGOLD, A. C. Congenital Kyphosis. . . . 451
- BOSE, K. S., AND BANERJEE, N. M. Ewing's Tumour of the Clavicle. . . . 452
- WILSON, J. N. Tuberculosis of the Elbow. A Study of Thirty-One Cases. . . . 452
- BRANSON, EDWARD C. Fractures of the Carpal Navicular. Accurate Diagnosis and Planned Treatment. . . . 452
- UMKER, WILLIAM, AND JAFFE, HENRY L. Ossifying Fibrosarcoma (Extraskeletal Osteogenic Sarcoma) of the Thigh Muscle. Report of a Case with Recurrence and Widespread Metastases More than Four and a Half Years After Excision. . . . 452
- SOMERVILLE, E. W. Development of Congenital Dislocation of the Hip. . . . 452
- HARRISON, M. H. M., ET AL. Osteoarthritis of the Hip: A Study of the Nature and Evolution of the Disease. . . . 453
- LANDELLS, J. W. The Bone Cysts of Osteoarthritis. . . . 453
- LLOYD-ROBERTS, G. C. The Role of Capsular Changes in Osteoarthritis of the Hip Joint. . . . 454
- CANDARDJIS, G., AND SAEGESSER, F. Arthrography of the Knee by the Double-Contrast Method. . . . 454
- NIDECKER, H. J. Concerning the Worth of Pneumoarthrography of the Knee Joint. . . . 454
- SCHÄRER, K. Arthrography of the Knee Joint with Positive Contrast Method. . . . 454
- The Genitourinary System**
- WEENS, H. STEPHEN, AND JOHNSTON, M. HARLAN. Thoracic Renal Ectopia. . . . 455
- BEGG, R. CAMPBELL. Sextuplicitas Renum: A Case of Six Functioning Kidneys and Ureters in an Adult Female. . . . 455
- BUNGE, RAYMOND G. Delayed Cystograms in Children. . . . 455
- BACON, HARRY E., ET AL. Significance of Ureteral Studies in Colonic and Rectal Surgery. . . . 455
- PECK, HYMAN. Nephrogram Following Acute Myocardial Infarction. . . . 456
- EPSTEIN, CARL C. Coronary Insufficiency Following Intravenous Pyelography. . . . 456
- Miscellaneous**
- COOPER, GEORGE, JR., ET AL. Emergencies in the Newborn. . . . 456
- CHARACHE, HERMAN. Tumors in One of Homologous Twins. Neuroblastoma; Fibromyxosarcoma in Infant Negro Twins. . . . 457
- GAUTIER, A., AND MAURICE, P. A. Hyperglobulinemic Purpura of Waldenstroem and Besnier-Boeck-Schaumann Disease. . . . 457
- Technic**
- TUDDENHAM, WILLIAM J., ET AL. Supervoltage Diagnostic Roentgenography. A Preliminary Report. . . . 457
- GORDON, ELIAS, AND SAURO, JOSEPH. A New Method of Stereoscopic Roentgenography: "Twist-Stereo" Method. . . . 457
- RADIOTHERAPY**
- QUIMBY, EDITH H., AND CASTRO, VICTORIA. The Calculation of Dosage in Interstitial Radium Therapy. . . . 458
- MORGAN, RUSSELL H., ET AL. Remote Fluoroscopic Control of Radiation Therapy by Screen Intensification. . . . 458
- KLIGERMAN, MORTON M., AND RICHMOND, JEANNE D. Volume Dosage Distribution in the Female Pelvis in Radium Therapy. . . . 459
- EPSTEIN, STEPHAN, ET AL. Influence of X-Ray Cones on the Dose. . . . 459
- CALVERT, J. W. Use of Duplast in Radiation Therapy. . . . 459
- ALEXANDER, EBEN, JR., AND ADAMS, STEWART. Tumor of the Glomus Jugulare. Follow-up Study Two Years After Roentgen Therapy. . . . 459
- ADLER, DENIS C., AND DEEB, PAUL H. Radiation Therapy in Carcinoma of the Thoracic Esophagus. . . . 460
- GARRETT, ROBERT A., AND MERTZ, H. O. Wilms's Tumor in Children. . . . 460
- HANSEN, POUL B. Sympathicoblastoma of the Adrenal Medulla with Osseous Metastases. Report of Three Cases Including One Surviving Eleven Years after Roentgen Therapy. . . . 460
- RADIOISOTOPES**
- BEHRENS, CHARLES F. Recent Advances in Radioisotope Therapy. . . . 461
- BLACK, B. MARDEN, ET AL. The Uptake of Radioactive Iodine by Carcinoma of the Thyroid Gland: A Study of 128 Cases. . . . 461
- BURROWS, BELTON A., AND ROSS, JOSEPH F. The Thyroidal Uptake of Stable Iodine Compared with the Serum Concentration of Protein-Bound Iodine in Normal Subjects and in Patients with Thyroid Disease. . . . 461
- SZILAGVI, D. EMERICK, ET AL. A Radioiodine Tracer Study of the Fate of Human Thyroid Autotransplants. . . . 462
- RALL, J. E., ET AL. The Blood Level as a Guide to Therapy with Radioiodine. . . . 462
- STURGEON, CHARLES T., ET AL. Treatment of Thyroid Cancer Metastases with TSH and I^{131} During Thyroid Hormone Medication. . . . 463

- JEPSON, R. P., ET AL. Removal from Skin of Plasma Protein Labeled with Radioactive Iodine..... 463
- SIEGEL, EDWARD. Low-Cost I¹³¹ Thyroid Uptake Apparatus..... 463
- BARNUM, CYRUS P., ET AL. A Time Study of the Incorporation of Radiophosphorus into the Nucleic Acids and Other Compounds of a Transplanted Mouse Mammary Carcinoma..... 463
- COOPER, JOHN A. D., AND ZORN, ELINOR M. Distribution of Colloidal Radioactive Chromic Phosphate After Intracavitary Administration in the Rat..... 463
- GABRIELI, ELEMER R., AND AUSKAPS, AINA A. Effect of Whole Body X-Irradiation on the Reticulo-Endothelial System as Demonstrated by the Use of Radioactive Chromium Phosphate..... 464
- JACKSON, ANDREW H., ET AL. Uptake of Subcutaneous and Intramuscular Silver-Coated Radioactive Gold Colloids by Lymph Nodes in Dogs..... 464
- FEINSTEIN, A. R., ET AL. A New Method, Using Radioiron, for Determining the Iron-Binding Capacity of Human Serum..... 464
- LEMMON, RICHARD M. Radiation Decomposition of Carbon-14-Labeled Compounds..... 464
- MAYR, GIOVANNA, ET AL. Boron Detection in Tissues Using the (γ, α) Reaction..... 465
- RADIATION EFFECTS; PROTECTION; EXPERIMENTAL STUDIES**
- WHITEHOUSE, WALTER M., AND LAMPE, ISADORE. Osseous Damage in Irradiation of Renal Tumors in Infancy and Childhood..... 465
- KOK, G. Spontaneous Fractures of the Femoral Neck After the Intensive Irradiation of Carcinoma of the Uterus..... 465
- PERSKY, LESTER, AND AUSTEN, GEORGE, JR. ACTH in Radiation Cystitis..... 465
- COGAN, DAVID G., AND DREISLER, KNUD K. Minimal Amounts of X-Ray Exposure Causing Lens Opacities in the Human Eye..... 466
- HAM, WILLIAM T., JR. Radiation Cataract..... 466
- MORGAN, RUSSELL H. Protection from Roentgen Rays..... 466
- SPALDING, CHARLES K., ET AL. Radiation Exposure Survey of X-Ray and Isotope Personnel..... 467
- CLARK, STANLEY H. Stray Radiation Levels in the Vicinity of Betatrons..... 467
- LOOSEMORE, W. R. Monitoring of Water for Fission-Product Contamination..... 467
- HERRINGTON, A. C., ET AL. Economic Evaluation of Permanent Disposal of Radioactive Wastes..... 467
- SCHULMAN, JAMES H., ET AL. Radiophotoluminescence Dosimetry System of the U. S. Navy..... 467
- COGAN, DAVID G., ET AL. Experimental Radiation Cataract. III. Further Experimental Studies on X-Ray and Neutron Irradiation of the Lens..... 468
- MOSES, CAMPBELL, ET AL. Experimental Production of Radiation Cataracts by Fast Neutrons..... 468
- VON SALLMANN, LUDWIG, ET AL. Effects of Beta Irradiation on the Rabbit Lens..... 469
- NICKSON, JAMES J., ET AL. Roentgen Rays and Wound Healing. II. Fractionated Irradiation. An Experimental Study..... 469
- KULLANDER, STIG. The Frequency of Ovarian Tumours and of Estrus in Mice Treated with Roentgen Radiation and Hormones..... 469
- ODEBLAD, ERIK. A Study on the Protective Action of 2,3-Dimercaptopropanol (BAL) on Radiation-Induced Changes in the Ovarian Follicles in Mice..... 470
- COLE, LEONARD J., AND ELLIS, MARIE E. Age, Strain and Species Factors in Post-Irradiation Protection by Spleen Homogenates..... 470
- FITCH, FRANK W., ET AL. A Study of Antigen Localization and Degradation and the Histologic Reaction in the Spleen of Normal X-Irradiated, and Spleen-Shielded Rats..... 470
- LORENZ, EGON, ET AL. Prevention of Irradiation-Induced Lymphoid Tumors in C57BL Mice by Spleen Protection..... 470
- KAPLAN, HENRY S., ET AL. Influence of Bone Marrow Injections on Involution and Neoplasia of Mouse Thymus After Systemic Irradiation..... 471
- HILFINGER, MARTIN F., JR., ET AL. Effect of Homologous Bone Marrow Emulsion on Rabbits after Total Body Irradiation..... 471
- CHANUTIN, ALFRED, ET AL. Effect of Phenylhydrazine and X-Irradiation on Red Cell Destruction and Serum Iron Concentration..... 472
- CHANUTIN, ALFRED, ET AL. Effect of Phenylhydrazine and X-Irradiation on Iron Deposition in Tissues of Intact and Splenectomized Rats..... 472
- DE LEEUW, NANNIE K. M., ET AL. Proteolytic Enzyme Studies in Irradiated Rabbits..... 472



ROENTGEN DIAGNOSIS

THE HEAD AND NECK

Technique and the Dangers of Cerebral Angiography. G. F. Rowbotham, Rankin K. Hay, A. R. Kirby, B. E. Tomlinson, and Marjorie E. Bousfield. *J. Neurosurg.* 10: 602-607, November 1953.

The authors present a study of the technic used and complications encountered in a series of 430 patients undergoing cerebral angiography. There were 15 severe and permanent complications, including 3 deaths, and 18 transient complications. The causes of complications are reviewed and suggestions made for their avoidance.

In the majority of patients the injections were made percutaneously under local anesthesia. Each injection consisted of 12 c.c. of a preparation containing either 35 or 42.5 per cent Diodone (the diethanolamine salt of 3:5-di-iodo-4-pyridone-N-acetic acid). The injections were made at room temperature, and the speed and force were dependent upon strong thumb pressure on the plunger of the syringe. A 4-inch 17-G needle was employed, and the time taken to empty the syringe was two seconds. Normal saline was used to keep the needle clear of blood clot.

The authors believe that proper selection of patients is most important in avoiding complications. Among 22 patients with cerebral thrombosis, they encountered 1 death and 1 permanent and 4 transient complications. Angiography is also dangerous in the acute and sub-acute phases of a head injury. Next in importance as regards complications seems to be the number of injections, the probability of a reaction increasing with repeated injections.

A total of 6 patients came to autopsy within ten days following cerebral angiography, although in only 3 was the procedure thought to have caused or contributed to death. In all 6 cases there had been some periarterial bleeding as well as laceration of the intima of the arteries used for injections. Of the 3 cases in which death was attributed to angiography, 2 showed a large number of hyaline thrombi in capillaries and arterioles with swelling and necrosis of the vessel walls. The other showed thrombosis of the right middle cerebral artery with infarction of part of the corresponding hemisphere, apparently precipitated by the angiographic examination.

In an attempt to determine if the force of injection could cause damage to the cerebral capillaries, injections were made into the common carotid arteries of 2 patients while cinematographic records in color were made of the cerebral cortex about the sylvian fissure. With the technic used for angiography there were dramatic color changes: within a few seconds the cortex went through a cycle of blushing, blanching, blushing, and return to normal color. When injections were made slowly, there were no color changes. From these studies the authors conclude that it would be possible, by rapid injection, to cause severe ischemia of part of the brain. They recommend, among other things, the designing of a new syringe by which a minimal force of injection will insure adequate concentration of the medium, and the preparation of a contrast material which can be injected slowly with satisfactory radiographic results.

One table.

JOHN J. CRAVEN, M.D.
Cleveland Clinic

Cerebral Arteriography with Sodium Acetizoate (Urokon Sodium) 30%. William B. Seaman and Henry G. Schwartz. *Arch. Surg.* 67: 741-745, November 1953.

The authors used intracarotid injections of Urokon Sodium 30%, in most instances by the percutaneous method, with local anesthesia, in obtaining 297 cerebral arteriograms in 125 patients. The average number of injections per patient was 2.4, with 9 c.c. per injection. Seven major and 20 clinically insignificant, fleeting, minor reactions were encountered.

The seven major reactions, representing a case incidence of 5.6 per cent, consisted of monoplegias, hemiplegias, and aphasias, usually clearing in from one-half hour to six days. One patient died twenty-four hours after decerebrate rigidity appeared following carotid injection. A subsequent ventricular tap yielded bloody fluid under increased pressure. Autopsy demonstrated a glioma of the pons with hemorrhage. In a second patient left hemiplegia developed after injection, and immediate craniotomy disclosed a metastasis 2 inches in diameter in the right parietal region. Death occurred twenty-four hours following surgery. The 7 cases with major reactions are briefly reported.

The authors conclude that 30 per cent Urokon, although not ideal, is a satisfactory contrast medium for cerebral arteriography.

R. F. LEWIS, M.D.
Cleveland Clinic

Studies of Pressures in the Carotid Artery of Patients Undergoing Cerebral Angiography. W. Eugene Stern. *J. Neurosurg.* 10: 577-582, November 1953.

By studying intracarotid arterial pressures and relating them to the radiologic patterns of arterial filling, the author attempted to obtain further data as to the adequacy of the distribution mechanism of the circle of vessels at the base of the brain. He hoped to be able to prognosticate from angiographic studies how much residual pressure was to be expected after carotid artery occlusion.

Measurements of intracarotid arterial pressure during unilateral and bilateral occlusion of the common carotid arteries were made in 14 patients. From these it was concluded that there is no reliable correlation between the amount of pressure fall after ipsilateral and bilateral carotid arterial occlusion and the presence or absence of bilateral filling of the anterior half of the circle of Willis or the filling of the posterior half ipsilaterally. The only exception was an association between the preservation of high residual systolic and diastolic pressures after unilateral occlusion and the presence of bilateral filling of the anterior cerebral arteries.

Two figures; 1 table. JOHN J. CRAVEN, M.D.
Cleveland Clinic

Surgical Treatment of Aneurysms of the Anterior Communicating Artery. Gösta Norlén and Alec S. Barnum. *J. Neurosurg.* 10: 634-650, November 1953.

The authors report their results in the surgical treatment of 24 patients with aneurysms of the anterior communicating artery. In 15 they were able to ligate or clip the neck of the aneurysm, which they consider the treatment of choice. In this group there was only one operative death and no patient died from recurrent

hemorrhage. However, as is stated, the time elapsed since surgery is, in most of the cases, too short to permit any conclusions regarding late results. Other procedures used include ligation of the common carotid artery, muscle or gelfoam packing around the aneurysm, complete resection of the aneurysmal sac, and trapping of the aneurysm by occlusion of the communicating artery.

Cerebral arteriography prior to surgical intervention, while admittedly dangerous in these patients, is considered essential because of the possibility of multiple aneurysms. Also, it is imperative to establish the state of the collateral circulation between the hemispheres and to exclude anomalies of the circle of Willis. In 26 cases of aneurysm of the anterior communicating artery in which arteriography was done, the radiologist was able to state the location in all.

Seven illustrations, including 4 roentgenograms; 3 tables.

JOHN J. CRAVEN, M.D.
Cleveland Clinic

Teratoma of the Larynx. Leighton F. Johnson and M. Stuart Strong. *Arch. Otolaryng.* 58: 435-441, October 1953.

The authors present a case of teratoma of the extrinsic larynx in a 50-year-old man.

Benign tumors of the larynx are sometimes allowed to grow to an astonishing size before advice is sought, their growth rate being so slow that the patient is able to tolerate the gradual increase of dysphagia and dyspnea for many years. In the authors' case there had been increasing difficulty in breathing for ten years. Soft-tissue roentgenograms of the neck revealed a mass in the upper part of the larynx which partially obliterated the air column and presented areas of calcification. Laminagrams outlined a mass which in the anteroposterior view showed lateral displacement of the right wing of the thyroid cartilage and upward displacement of the right greater cornu of the hyoid bone.

External operation with an elective tracheotomy is usually necessary for large tumors of the extrinsic larynx. The approach employed will be suggested by the location of the tumor. Most commonly, laryngofissure, with or without division of the thyrohyoid membrane, has been used.

Two roentgenograms; 3 photomicrograms; 1 photograph.

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THE CHEST

Pulmonary Lesions from Bronchography with Joduron B on the Basis of Empiric and Experimental Observations. A. Werthemann. *Radiol. clin.* 22: 511-518, 1953. (In German)

The author's interest in the possible deleterious effects of bronchography with water-soluble media was occasioned by the examination of the right middle and lower lobes of a thirty-four-year-old man, removed at operation because of a bronchial adenoma. Thirteen days after the operation the patient expired, following a bilateral necrotizing pneumonia that failed to respond to chemotherapy and antibiotics. Bronchography had been done twenty-three days before death, with one of the new water-soluble substances that uses carboxymethylcellulose to enhance its viscosity. The lungs at autopsy disclosed organizing inflammatory foci and fine granular streaked masses. These were regarded as representing a foreign-body reaction occasioned by

carboxymethylcellulose used in Joduron. Six more cases were studied, and in these, also, masses were found, at times as inflammatory granulomas, characteristic scars, and granulation tissue formations.

In an earlier paper (Werthemann and Vischer: *Schweiz. med. Wchnschr.* 81: 1077, 1951. *Abst. in Radiology* 59: 594, 1952), the author reported his experiments on rats and guinea-pigs, with diluted Joduron B (Cilag) injected intratracheally, and also a water-soluble cellulose preparation. The carboxymethylcellulose could still be seen in the lungs after one and one-half years.

The author believes that he has discredited the opinions of Zollinger (Zollinger and Fischer: *Schweiz. med. Wchnschr.* 83: 645, 1953. *Abst. in Radiology* 62: 893, 1954), who believed that these granulomas are initiated by mucus, and who was unable to produce them experimentally by percutaneous injection of Joduron B into the lungs. This last experimental technic bears no relation to the usage of the substance in man.

The untoward effects of Joduron B are not considered to discredit this medium, since untoward effects have been associated with other great therapeutic strides, such as sulfonamide therapy, thiouracil, etc. Joduron represents a distinct advance over Lipiodol. It is to be borne in mind, however, that carboxymethylcellulose is not resorbed as completely as was once thought and that, under certain conditions, it can lead to permanent lung damage.

[For other studies of the effects of water-soluble media for bronchography, see Weber: *Fortschr. a. d. Geb. d. Röntgenstrahlen* 79: 168, 1953; and Hellström: *Acta radiol.* 40: 371, 1953. *Abst. in Radiology* 62: 894, 1954, and 63: 283, 1954.]

CHRISTIAN V. CIMMINO, M.D.
Fredericksburg, Va.

Bronchography with a Water-Soluble Contrast Medium (Umbradil). Sol Katz, Patrick B. Storey, Georges F. McCormick, Hector Palacios, and Angel DeLeon Penso. *Am. Rev. Tuberc.* 68: 760-770, November 1953.

After using the water-soluble Umbradil for bronchography on 45 patients over a period of eighteen months, the authors conclude that it is not a very satisfactory medium, chiefly because of its irritating effect, producing uncontrollable cough. Nevertheless, Umbradil is probably of value in selected cases in which bronchography limited to one lobe or segment is desired and in which retention of the contrast medium in the lung is especially undesirable.

Fifteen roentgenograms. JOHN H. JUHL, M.D.
Minneapolis, Minn.

Acute Iodism Following Use of Chloriodized Oil (Iodochlorol) in Bronchography. Report of a Case. Martin Asch. *Arch. Otolaryng.* 58: 536-539, November 1953.

A case of acute iodism and bronchopneumonia subsequent to bronchography with chloriodized oil (Iodochlorol) is presented. This case is believed to be the first of its kind recorded in the literature. Chloriodized oil contains 27 per cent iodine and 7.5 per cent chlorine organically combined with a highly refined peanut oil.

A 53-year-old engineer was admitted to the hospital two days after he had undergone bronchography with chloriodized oil. He had gagged considerably during

the procedure, and apparently some of the contrast medium was swallowed. Shortly thereafter he began to complain of dull pain in the left lateral chest over the third and fourth ribs. Localized plaques of edema appeared over the buttocks, forearms, and fingers. The patient was hospitalized when hemoptysis occurred and dyspnea increased. He had a chronic necrotizing pyoderma of the buttocks, trunks, and lower extremities, present for thirty-two years, with severe exacerbations during the past year. This was associated with a chronic glomerulonephritis. X-ray examination revealed a left basal pneumonitis. Urinalysis showed albumin 2 plus, 10 to 12 white blood cells per high-power field, many hyaline and granular casts. Total serum iodine was 65 γ per 100 c.c.; one week later it was 35 and one month later 8 γ . The pneumonic process resolved uneventfully on a regimen consisting of streptomycin and Terramycin systemically, postural drainage, and oxygen by nasal tube. Neomycin ointment was applied locally to the skin lesions, with subsequent improvement.

The pathogenesis of the left basal pneumonitis followed by bilateral bronchopneumonia is not clear. The complete resolution of the pneumonic process within three weeks makes a diagnosis of lipoid granuloma formation unlikely. The elevated blood iodine level is also difficult to explain. Iodochlorol is routinely tested by incubation at 140° F. for ten days, and it is claimed that this test fails to disturb the stability of the chemical combination. A possibility which has to be considered in the present case is that a fair amount of the iodized oil was probably swallowed when the patient experienced gagging and difficulty during the bronchographic procedure. After digestion by the gastrointestinal enzymes, iodine could have been liberated and absorbed into the circulation *via* the intestinal mucosa.

[It is not stated whether the patient was tested for sensitivity to iodine before bronchography.—Ed.]

The Value of Bronchography as a Special Diagnostic Procedure in Pulmonary Tuberculosis. Ernst J. Fischer. *Fortschr. a. d. Geb. d. Röntgenstrahlen* 79: 590-599, November 1953. (In German)

In view of the ever increasing performance of segmental resections and lobectomies, more detailed diagnostic methods are warranted for exact localization of pathologic foci and for determining their segmental relation to the bronchial tree. Ordinary procedures and planigraphy are frequently inadequate, and bronchoscopy is not helpful when lesions are located peripherally, revealing tuberculous bronchitis in barely 50 per cent of the cases. Therefore, bronchography with aqueous solutions is advised, especially in the presence of cavernous lesions when collapse therapy does not result in cavity closure. It is also helpful when lymph node perforation is suspected, when a lesion fails to show therapeutic response, when sputum is positive and the roentgenogram negative, and when pulmonary infiltration is atypical, with large areas of diffuse clouding and a not readily explainable course. Another important application is for exact localization of a lesion prior to surgical procedures.

The author differentiates three types of bronchial-wall damage: (1) diffuse endobronchitis, especially in cavity drainage, which may extend even to the stem bronchus and trachea; (2) localized bronchitis due to perforation of a caseous lymph node, ranging from cir-

cumscribed edema to fistula formation; (3) multiple small bronchiolar foci of hematogenous origin, which may advance to wall destruction. All three types may coexist.

Eight roentgenograms.

E. KRAFT, M.D.
Newington, Conn.

Oblique Tomography and Its Significance for Localization of Pulmonary Disease. G. Mark. *Fortschr. a. d. Geb. d. Röntgenstrahlen* 79: 567-581, November 1953. (In German)

Although most pulmonary lesions can be detected by sagittal tomography, the oblique anteroposterior method is helpful for eliminating disturbing smudges produced by the shoulder and spine. It is ideal for demonstrating the bronchial tree, hilar formations, and interlobar fissures. In right oblique tomography the left side of the patient is elevated and rests on a 45° angle block. For a left oblique tomogram the right side is similarly elevated.

For right oblique tomograms, 9 cm., 10 cm., 11 cm., and 12.5 cm. levels are used. The right stem bronchus is seen at the 12.5 cm. level and its branches at the 11 cm. level, the pulmonary artery at the 10 cm. level, and the peripheral arteries at 9 cm. On the left side the levels are at least 1 cm. closer to the table top, so that the 10 cm. level shows the stem bronchus and branches.

The method is useful for accurate segmental localization of lesions, for demonstration of atelectasis, and for peripheral lesions close to the ribs. It is used either as a supplement to sagittal tomography or independently.

Six examples are given to illustrate the advantages of the procedure in special situations.

Seventeen roentgenograms; 1 photograph; 4 diagrams.
E. KRAFT, M.D.
Newington, Conn.

Bronchial Disease in Lungs Resected for Pulmonary Tuberculosis. Donald E. Olson, Francis S. Jones, and D. Murray Angevine. *Am. Rev. Tuberc.* 68: 657-677, November 1953.

Of a total of 658 consecutive surgical specimens resected from patients with pulmonary tuberculosis, 602 were considered adequate for a complete appraisal of the pathology. Extensive histopathologic studies were made and the findings are correlated in a series of tables. Eighty patients were examined by bronchography and 62 were found to have bronchiectasis, but this was confirmed in only 37 (60 per cent) of the specimens. Tuberculous bronchitis was found in 6 and chronic bronchitis in 16 of the remaining specimens, leaving only 3 of the group with normal bronchi. The authors point out, however, that careful pathologic examination of all bronchi in the entire specimen may uncover lesser degrees of bronchiectasis in some cases. Filling of small cavities and distortion produced by bronchitis may also have simulated bronchiectasis in some instances. Of the 18 patients with normal bronchograms, 7 were found to have endobronchial tuberculosis and 5 had histopathologic evidence of bronchiectasis.

Bronchoscopy was performed shortly before surgery on 582 patients and 462 (79 per cent) were reported as revealing normal bronchi; 46 (8 per cent) had red or friable mucous membranes, 33 (6 per cent) had tuber-

culous bronchitis, and 41 (7 per cent) had bronchial stenosis. Only 10 per cent of the specimens with normal bronchoscopic findings were found to have normal bronchi on histopathologic examination. The location of disease undoubtedly accounts for this lack of correlation.

Only 10 per cent of the specimens showed normal bronchi, despite the fact that many of the patients had minimal and moderately advanced tuberculosis and most of the disease was non-cavitary. Chronic bronchitis was found in 29 per cent of specimens, tuberculous bronchitis in 20 per cent, bronchiectasis without endobronchial tuberculosis in 21 per cent, and bronchiectasis with endobronchial tuberculosis in 20 per cent. Endobronchial tuberculosis was present in 40 per cent of specimens and bronchial ectasia in 42 per cent. The tuberculous bronchial lesions were most frequently associated with "cellular" and open cavitary parenchymal foci and were more common in patients with moderate or far advanced disease, in disease of less than three years duration, and in lobectomies and pneumonectomies (in contrast to segmental resections). These lesions were also more common in patients without or with less than four months of Streptomycin-PAS therapy; while this therapy had no effect on the incidence of bronchiectasis, which was more frequently associated with fibrocaseous parenchymal foci, with moderate to marked interstitial pulmonary fibrosis, with disease of more than three years duration, and with moderately or far advanced disease.

Seven photomicrographs; 11 tables.

JOHN H. JUHL, M.D.
Minneapolis, Minn.

Histoplasmosis in Non-Endemic Regions. Leon J. Spitz and Benjamin Schwartz. *Am. J. Med.* 15: 624-632, November 1953.

It is well known that histoplasmosis is a frequent cause of pulmonary disease in endemic regions. All too frequently, however, this possibility has been given scant consideration in non-endemic areas.

Roentgenologically, histoplasmosis may simulate many forms of pulmonary disease. Four types of pulmonary lesions have been observed: (1) disseminated calcifications; (2) coin lesions; (3) infiltrations; (4) mediastinal masses.

Skin tests with tuberculin, histoplasmin, and coccidioidin must be done routinely in the diagnostic work-up of pulmonary conditions if histoplasmosis is to be detected. A complement-fixation test is of relatively minor importance in revealing inactive cases of the disease, though it may furnish confirmatory evidence of histoplasmosis in the presence of a positive skin reaction.

In the course of eighteen months, the authors accumulated a series of 19 cases with pulmonary lesions in which a histoplasmin skin test was positive and the tuberculin and coccidioidin skin tests were negative. In addition, they have discovered 18 patients with similar pulmonary pathologic disorders on chest roentgenograms, in whom both histoplasmin and tuberculin skin tests were positive and the coccidioidin skin tests were negative. These cases were all detected in a non-endemic area (Brooklyn, N. Y.).

Seven roentgenograms; 2 tables.

HOWARD L. STEINBACH, M.D.
University of California

An Important Sign for the Roentgenographic Diagnosis of Chronic Lung Abscesses. Günter Liess. *Fortschr. a. d. Geb. d. Röntgenstrahlen* 79: 613-622, November 1953. (In German)

The roentgen diagnosis of a lung abscess which communicates with the bronchial system is simple, but the diagnostic problem may become difficult when such a communication is absent and the contents of the abscess cannot be evacuated through expectoration. Under these conditions the inspissated pus and detached necrotic lung tissue may be indistinguishable from the surrounding pneumonitis. In such cases one has to differentiate between closed lung abscess, pneumonia, bronchogenic tumor with atelectasis, and interlobar empyema.

A crescent-shaped area of radiolucency over the mass is considered strongly suggestive of abscess with a trace of gas between its wall and contents. Five proved cases exhibiting this sign are reported and well illustrated. All cases were treated conservatively at first, but lobectomy was finally necessary for a cure.

It is the author's impression that the sign is helpful in diagnosis of a closed lung abscess and in determination of its size and location.

Eleven roentgenograms; 1 photograph.

S. W. WESTING, M.D.
Newington, Conn.

Localized Pulmonary Hypertrophic Emphysema. William A. Johns. *Virginia M. Monthly* 80: 618-620, November 1953.

Emphysema confined to a single lobe with no apparent cause seems to be a distinct subdivision of congenital cystic disease of the lungs. According to the author only about 15 cases have been reported to which he adds one more, in a child of nine years.

Preoperatively the chest film showed marked radiolucency of the left upper lung field (typical location, since no cases have been seen in the lower lobes) with compression of the vascular markings in the lower half and considerable shifting of the heart to the right. The history as recorded was not significant and the only positive physical findings related to the cardiac shift. Lobectomy was performed with excellent results.

The author mentions that in all previous cases treated by lobectomy the patient has survived while all cases not operated upon have terminated fatally.

Three roentgenograms; 1 photomicrograph; 1 photograph.
ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Surgical Treatment of Bullous Emphysema. Contributions of Angiocardiography. Laurence Miscall and Robert W. Duffy. *Dis. of Chest* 24: 489-499, November 1953.

Diminished pulmonary function and distressing symptoms due to pulmonary cysts, blebs, and localized emphysema may, in selected cases, be relieved by surgical resection of the involved pulmonary tissue. Resection is especially indicated when expansion of the compressed and potentially functioning remaining lung tissue can be obtained. For determining the extent of irreversibly damaged lung that can be removed and the volume of compressed lung in which function can be restored, it is important to determine the distribution of the anatomic changes. Angiocardiography provides accurate preoperative evaluation in this respect.

Because of its greater safety and reliability, it is preferable to endobronchial instillation of oil for bronchographic examination. It is pointed out that oil bronchography in patients with minimal ventilatory reserve is not without risk and it should not be a routine diagnostic procedure.

Seventeen roentgenograms.

WYNTON H. CARROLL, M.D.
Shreveport, La.

Rare Causes or Forms of Intermittent and Constant Atelectasis. H. J. Gombert. *Fortschr. a. d. Geb. d. Röntgenstrahlen* 79: 599-613, November 1953. (In German)

The principal causes of atelectasis are (1) endobronchial occlusion as by bronchogenic carcinoma and foreign-body impaction, (2) stenosis due to extrinsic compression, (3) spasm of a bronchus or lung, and (4) compression due to pleural effusion.

The direct signs are haziness, clouding, or triangular areas of increased density. Indirect signs may be either dynamic (mediastinal shift during inspiration and expiration) or static (unilateral elevation of the diaphragm, increased radiolucency of adjacent structures, and retraction of the hemithorax). The best methods for diagnostic confirmation are bronchoscopy and bronchography.

Three cases are described. The first patient had seasonal atelectasis of the left lower lobe, in the spring and autumn, following poliomyelitis with hemiparesis. The second patient had bronchogenic carcinoma of the right upper lobe with constant atelectasis. Tumor particles extended downward to the right middle and lower lobes, causing intermittent atelectasis due to a check-valve mechanism. After sequestration and expectoration of the satellite tumor particles, the intermittent atelectasis disappeared. A third patient had a carcinoid neoplasm of the right lower lobe and aplasia of the corresponding middle and lower lobes. An associated intermittent atelectasis of the right upper lobe was caused by fibrinous bronchitis and was relieved following expectoration of a fibrinous cast of the bronchial tree.

Sixteen roentgenograms; 2 photographs.

E. KRAFT, M.D.
Newington, Conn.

Occupational Lung Damage in Ships' Repairers. Lasar Dunner, M. Sanger Hicks, and D. J. T. Bagnall. *Brit. J. Radiol.* 26: 590-594, November 1953.

Evidence of pulmonary damage due to inhaled dust and/or fumes is reported, presumably for the first time, in men working as ship repairers—riveters, caulkers, chippers and scalers, plate removers. Analysis of the materials and dusts to which these workers are exposed showed the presence of free silica and iron compounds.

Thirty-one cases are presented in tabular form in men with histories of exposure ranging from eleven to forty-four years, often in confined spaces. Two broad groups are recognized: one with radiologically demonstrable lesions of varying extent, which may or may not be accompanied by significant clinical signs and symptoms of incapacity, and one without definite radiological changes.

The radiological findings so far noted are of the following types: (1) increased lung striations; (2) more marked lung reticulation combined with nodulation;

(3) severe irregular fibrosis without other apparent lesions; (4) a combination of reticulation, irregular fibrosis, and nodules of varying size; (5) emphysema. The extent of the radiological changes bears no relation to the degree of incapacity. Postmortem findings of severe emphysema with slight pneumoconiosis are reported in 2 men with extreme incapacity in the absence of roentgenologically demonstrable disease. Four roentgenograms; 3 tables.

SYDNEY J. HAWLEY, M.D.
Seattle, Wash.

"Primary" Undifferentiated Carcinoma in the Mediastinum. Report of Two Cases with Angiocardiographic and Pathologic Findings. Nathaniel Finby and Israel Steinberg. *Dis. of Chest* 24: 500-508, November 1953.

Two cases of "primary" undifferentiated carcinoma of the mediastinum are reported, with angiocardiographic and pathologic findings. In each instance opacification of the cardiovascular system clearly demonstrated displacements produced by the large mediastinal tumor. In one case actual invasion of the superior vena cava by the neoplastic tissue was demonstrated. The exact diagnosis could be established only after complete autopsy.

Roentgen therapy was given to both patients, but as in other reported cases, the disease ran a rapid fulminating course uninfluenced by treatment.

Thirteen roentgenograms; 1 photograph; 1 photomicrograph; 4 drawings.

WYNTON H. CARROLL, M.D.
Shreveport, La.

THE CARDIOVASCULAR SYSTEM

A Symposium on Thoracic Cardiovascular Surgery at the State University of Iowa. II. Roentgenologic Evaluation. Eugene F. Van Epps. *J. Iowa State M. Soc.* 43: 451-455, November 1953.

This report on the roentgen findings in the several cardiac conditions amenable to operative correction follows a discussion of the medical and physiologic aspects and precedes a consideration of surgical treatment.

In the *tetralogy of Fallot* three types of cardiac silhouette are seen roentgenologically: the commonly described "boot-shaped" heart of normal size, with rounded, elevated apex, narrow waist, and diminutive pulmonary radicles; a normal contour; prominence of the pulmonary artery segment due to post-stenotic dilatation. Angiography will show opacification of the right side of the heart and the pulmonary artery trunk, and may show, although not usually, the site of stenosis of the pulmonary artery, the peripheral pulmonary arteries, and simultaneous opacification of the aorta, indicating an overriding aorta and interventricular defect.

In *patent ductus arteriosus*, the fluoroscopic and radiographic findings include: varying degrees of cardiac enlargement; overactivity and increased amplitude of pulsation of the left ventricle, aorta, and pulmonary artery; evidence of a left to right shunt manifested by hilar dance, *i.e.*, actively pulsating hilar pulmonary artery radicles which are enlarged and which have increased density; not infrequent slight retrodisplacement of the barium-filled esophagus, indicating left auricular enlargement; left ventricular hypertrophy;

slight degree of right ventricular hypertrophy even in the absence of cardiac failure or other congenital abnormalities. Rarely, calcification may be seen in the ductus.

Plain films in *aortic coarctation* will frequently make possible a diagnosis because of rib notching or the double contour ("3" sign) of the descending aorta. The aortic knob may be normal but is usually small in spite of the evident left ventricular hypertrophy. By retrograde aortography the coarctation itself and the pathognomonic collateral vessels are visualized.

In uncomplicated *mitral stenosis* the left auricle, pulmonary artery and branches and the right ventricle will be enlarged. Calcification may be found in the mitral valve area. Other findings include a small or normal aortic knob and left ventricle and absence of systolic expansion of the left auricle.

In *constrictive pericarditis* the heart shadow is small or normal, with diminished pulsation. Pericardial calcification occurs in about 50 per cent of the patients, but all cases with calcified pericardium are not constrictive.

Seven roentgenograms. ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Tricuspid Insufficiency. Observations Based on Angiocardiography and Cardiac Catheterization in Twelve Patients. Charles T. Dotter, Daniel S. Lukas, and Israel Steinberg. *Am. J. Roentgenol.* 70: 786-791, November 1953.

Tricuspid insufficiency usually exists in association with rheumatic mitral stenosis. Autopsy studies have established this association in 33 per cent of the cases, while cardiac catheterization studies by the authors' group have indicated a similar incidence.

In general, routine roentgenologic methods leave much to be desired in the diagnosis of tricuspid insufficiency. When roentgenologic evidence of mitral stenosis exists without pulmonary congestive changes, tricuspid insufficiency is suggested, but in such cases the situation is usually apparent clinically.

The authors report on 12 patients with tricuspid insufficiency who were studied by angiocardiography and cardiac catheterization. All had chronic rheumatic mitral stenosis and auricular fibrillation and several were studied preliminary to mitral valve surgery. Angiocardiography in tricuspid insufficiency reveals dilatation of the superior vena cava and the right atrium. The width of the superior vena cava as measured in this series averaged 25.9 mm., approximately double the normal figure. Occasionally serial films will demonstrate a filling defect within the right atrium, due to regurgitation of non-opacified right ventricular blood through the incompetent tricuspid valve. The inconsistency of this "jet sign" facilitates differentiation from intra-atrial tumor or thrombus formation.

Seven roentgenograms; 7 drawings.

ROBERT H. LEAMING, M.D.
Memorial Center, N. Y.

Mitral Stenosis and Cor Pulmonale. Alberto C. Taquini, Bernardo B. Lozada, Reinaldo J. Donaldson, Robinson E. H. D'Aiutolo, and Enrique S. Ballina. *Am. Heart J.* 46: 639-648, November 1953.

Evaluation of patients with mitral stenosis has led the authors to differentiate a special type to which the name "mitral stenosis and cor pulmonale" has been

given. This state is characterized by: (1) a history of pronounced respiratory symptoms; (2) an extreme degree of dyspnea; (3) electrocardiographic and roentgenographic evidence of marked right ventricular hypertrophy; (4) the early appearance of congestive heart failure; (5) pronounced alterations in circulatory dynamics with extremely high pressures in the pulmonary circulation. Thirty cases of this entity have been reviewed.

Roentgenographically, these patients showed cardiac enlargement, due mainly to dilatation of the right ventricle, with marked dilatation of the pulmonary artery and its main branches, and with increased bronchovascular markings and clear lung fields. Left atrial enlargement was not marked.

The authors postulate that "mitral stenosis and cor pulmonale" could be the result of an increased resistance in the pulmonary circulation consequent to changes in the pulmonary vascular tree and in the lungs, and in part, at least, independent of the resistance represented by the narrowing of the mitral valve.

It is important to identify this type of case in the preoperative evaluation of patients with mitral stenosis, since it is felt that the pulmonary changes may be reversible if arrested at the initial stage of their development, but are most probably irreversible when far advanced.

Two roentgenograms; serial electrocardiograms; 3 tables.
THEODORE E. KEATS, M.D.
University of California

Functional Cor Triloculare. Freeman L. Rawson, Jr., and Alexander A. Doerner. *Am. Heart J.* 46: 779-783, November 1953.

The authors present the clinical and pathologic data on a patient with malrotation of the colon, dextrocardia, common ventricular origin of the aorta and pulmonary artery, and patent interventricular septum. It is remarkable that this patient attained the age of forty-seven years before dying of such extensive congenital heart disease.

The key anomaly, aside from dextrocardia, appeared to be the origin of the pulmonary artery and aorta from the same ventricle, leaving the other without an outlet except for a high interventricular septal defect. Without the latter, life would have been impossible; with it, the patient had, in effect, almost a three-chambered heart.

The authors consider this case an unusual variant of transposition of the great vessels.

Two roentgenograms; 1 electrocardiogram; 1 diagram.
THEODORE E. KEATS, M.D.
University of California

Myxoma of the Heart. Roentgen Diagnosis During Life in Three Cases. Israel Steinberg, Charles T. Dotter, and Frank Glenn. *Dis. of Chest* 24: 509-520, November 1953.

Three cases of left atrial intracavitary tumor were diagnosed during life by angiocardiography, which revealed a constant filling defect in an enlarged atrium, with attachment to the interatrial wall. This finding is not seen in mitral valvular stenosis due to rheumatic fever and serves to establish the diagnosis. Two of the cases came to necropsy and in each a histologic diagnosis of myxoma was made.

If the index of suspicion is high and every case with

mitral stenosis of obscure etiology and varying murmurs is carefully evaluated, more cases of myxoma will be discovered. With earlier operation, at a time when the patient is in good general condition, and finally, with advances in intercardiac surgery, especially the mechanical heart and lung apparatus, myxoma may become a curable disease.

Twelve roentgenograms; 2 photographs; 6 drawings.
WYNTON H. CARROLL, M.D.
Shreveport, La.

Persistence of Left Superior Vena Cava. Israel Steinberg, William Dubilier, Jr., and Daniel S. Lukas. *Dis. of Chest* 24: 479-488, November 1953.

Eleven cases of persistent left superior vena cava discovered during life by cardiac catheterization and angiocardiology are described and illustrated. By itself, a persistent left superior vena cava produces no detectable effects on the function of the heart but it is often associated with other congenital cardiac anomalies, frequently of a multiple complex type. Persistence of the left superior vena cava may be classified into three groups: (1) bilateral superior venae cavae without other congenital cardiac anomalies; (2) bilateral superior venae cavae with associated congenital cardiac anomalies; (3) absence of the right superior vena cava.

Several variations of bilateral superior venae cavae were encountered. The commonest variety consisted of separate bilateral systems with no intercommunication. Another variation consisted of a rudimentary intercommunicating innominate vein which allowed opacification during angiocardiology of both superior venae cavae. Still another type showed only a rudimentary left superior vena cava, most of the blood from the left side passing to the right superior vena cava via a large left innominate vein. One patient had double azygos veins as well as double superior venae cavae. This anomaly has been described six times in the anatomical literature. A left superior vena cava draining the entire venous brachiocephalic system, without a corresponding right superior vena cava, is also illustrated.

Although a left superior vena cava may be suspected on fluoroscopy, it can be positively identified in the living patient only by angiocardiology or cardiac catheterization. With the former procedure, the anomaly may be missed unless the left arm veins are used for injection of the contrast medium.

Thirteen roentgenograms; 6 drawings; 1 table.

WYNTON H. CARROLL, M.D.
Shreveport, La.

Aneurysm of the Thoracic Aorta and the Possibilities of Its Demonstration. G. Aurig and H.-J. Süssle. *Fortschr. a. d. Geb. d. Röntgenstrahlen* 79: 650-653, November 1953. (In German)

Aortography can be done in a retrograde fashion by injection of opaque material through a catheter introduced into a peripheral artery. This method, however, necessitates either ligation or suture of the artery. In view of this disadvantage, the method of Wickbom, calling for direct injection of the aorta (*Acta radiol.* 38: 343, 350, 1952. *Abst. in Radiology* 61: 448, 1953) was tried. The authors mention 6 cases in which this procedure was successfully employed and present a case of syphilitic aneurysm of the aortic arch in which the diag-

nosis could not be definitely established by fluoroscopy or kymography, but could be well recognized on the aortogram obtained by a modified Wickbom technic.

Three roentgenograms.

E. KRAFT, M.D.
Newington, Conn.

Peripheral Arteriosclerosis. Present Concepts of Management. Edwin J. Wylie and Richard E. Gardner. *California Med.* 79: 346-352, November 1953.

Three hundred patients with ischemic manifestations of peripheral arteriosclerosis form the basis of this report. As the study progressed, arteriography became the most important adjunct for the appraisal of such ischemic syndromes. Two interesting general statements are made: one that in 96 per cent of the series the significant occlusion was in a vessel the size of the popliteal or larger; the other, that two categories of peripheral arteriosclerosis may be differentiated, depending upon the size and extent of the occlusive process, namely, segmental arterial thrombosis or stenosis and diffuse arterial thrombosis or stenosis. In each the basic lesion is complete or nearly complete arterial occlusion.

The early arteriosclerotic lesion is a short zone of intimal thickening which, as it increases in depth, gradually encroaches upon the arterial lumen. This is most commonly observed near the orifice of a major arterial branch. Dilatation of the collateral vessels by-passing the stenotic zone is frequently observed in arteriograms taken at this stage. When complete occlusion develops in the stenotic segment, the static column of blood proximal and distal to the level of occlusion clots as far as the level of major arterial branches. Arteriograms taken at this time usually show filling of a major collateral artery at the proximal level of occlusion and a return flow of blood into the thrombosed artery at the level of occlusion by reverse flow through the distal collateral artery.

Symptoms of the segmental type of involvement are somewhat variable; they include pain in the low back or hip, weakness or fatigability in gluteal or thigh muscles produced by walking and relieved by rest, and impotence in males. The authors have performed thromboendarterectomy in 58 patients of their series. Forty-two of this number were significantly improved, while 8 died.

Diffuse arteriosclerosis is characterized arteriographically by multiple irregularities of the arterial lumen throughout the length of the arterial tree. In all cases studied in this category, there was one zone or more of complete occlusion or pronounced stenosis. Therapy for patients with peripheral ischemia secondary to diffuse arteriosclerosis is limited to palliative measures.

Fourteen roentgenograms; 1 photograph; 2 tables.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

The Technic and Interpretation of Lower Limb Phlebography. A. M. Boyd, B. N. Catchpole, R. P. Jepson, and S. S. Rose. *Ann. Surg.* 138: 726-733, November 1953.

Still another scheme for lower limb phlebography is presented, using a polyethylene tube inserted into an exposed dorsal foot vein. Twenty milliliters of contrast medium are injected smoothly in fifty to sixty seconds and a film is exposed to include the lower leg

(and knee) in lateral position at the end of the injection. The first film is inspected and, if the valves in the popliteal vein are competent, a second roentgenogram of the femoral vein (done with a second injection of contrast material) is made with the patient performing the Valsalva maneuver. If the valves are incompetent the Valsalva maneuver is not used.

The authors emphasize the importance of a thorough knowledge of the normal anatomic variations of the venous system for proper interpretation of the phlebograms. To be borne in mind is the "streamlined" blood flow sometimes present under normal conditions, the possible presence of normal veins of small caliber, and recanalization of occluded veins in post-phlebotic conditions. Non-filling of a vein may be due to a variety of conditions. It may be in spasm, blocked by a thrombus, locally occluded, or normal. Venospasm, to the point of complete occlusion, may be associated with a recent acute thrombophlebitis, which will be suggested clinically. The diagnosis of intraluminal thrombosis should be made with care; much help may be obtained from the presence of collateral veins by-passing the area. Dilution of the medium is sometimes seen proximal to the site of an arteriovenous fistula or at the ends of the column of contrast substance. This should not be interpreted as a filling defect.

The authors are not very clear as to the indications for the procedure but do stress that the results must be interpreted together with functional tests. Normal and abnormal findings are illustrated.

Ten roentgenograms; 1 photograph; 1 table.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

THE DIGESTIVE SYSTEM

Graduated Clinical Pre-detection of Digestive Tumors. Initial Results of the First Systematic Detection Center. Guy Albot, Monique Parturier-Albot, Nadine Bernard, Gustave Legeron, and Henri Dressler. *Am. J. Digest. Dis.* 20: 341-348, November 1953.

Rejecting other methods of detection of cancer of the digestive tract in population masses as either impractical or too expensive, the authors present their own procedure for selection of patients for detailed study. It consists merely of careful history taking by trained men and exclusion of all whose symptoms indicate either benign or functional etiology. Their main interest was gastric cancer but cases were also found involving the esophagus and large bowel.

Statistically the results seem good, with 57 cancers detected in 2,799 patients, but comparison of a series of patients with definite symptoms of malignant disease with mass surveys in which any patient with symptoms was excluded from the study is, of course, not warranted. Actually nothing was done that an astute general practitioner does not do routinely.

Three tables. ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Thoracic Duplication of Alimentary Tract. George William Ware and Harold A. Conrad. *Am. J. Surg.* 86: 264-272, September 1953.

Duplications of the alimentary tract have been defined as "spherical or tubular structures which possess a well developed smooth muscle layer and are lined with a mucous membrane. They are found at any level from

tongue to anus and usually are intimately attached to some portion of the alimentary tube" (Gross *et al.*: *Pediatrics* 9: 449, 1952. *Abst. in Radiology* 60: 304, 1953). These lesions have been variously described as enteric cysts, gastric cysts, esophageal duplications, mediastinal cysts of foregut origin and enterogenous abnormalities. The name, duplication of the alimentary tract, was first proposed by Ladd (South, M. J. 30: 363, 1937), and this phrase would seem to embrace the field. By merely adding the word thoracic or abdominal, a further distinction can be made.

The authors have collected from the literature 79 cases of thoracic alimentary tract duplication and add 2 of their own. The most common roentgen finding was a round, well defined mass in the posterior mediastinum.

Surgery was performed in both of the authors' cases. In the first, the diagnosis was enteric cyst of the thorax with (1) intestinal mucosa lining, (2) focal areas of gastric mucosa, (3) pancreatic tissue and submucosa. In the second the mass was found to originate from the esophagus and to be partly encircled by its muscular fibers. Histologically it was diagnosed as a "foregut cyst."

Six roentgenograms. ALFRED O. MILLER, M.D.
Louisville, Ky.

Adenocarcinoma and Leiomyosarcoma Occurring in the Same Stomach—Case Report. J. L. Smoot. *Virginia M. Monthly* 80: 621-623, November 1953.

No example of coincidence of adenocarcinoma and leiomyosarcoma in the stomach could be found in the literature, but the author presents a clear-cut case proved pathologically.

The patient, a sixty-eight-year-old colored male, gave a three-month history of increasing pain, weight loss, vomiting, and some melena. A 10 cm. mass was palpable in the epigastrium. Roentgen examination of the stomach was reported as showing "an ulcerating lesion of the pylorus and a filling defect in the mid-portion of the stomach." Subtotal gastric resection was done and the two tumors (the carcinoma was the ulcerated pyloric lesion) were found, with normal mucosa between.

One roentgenogram; 3 photomicrographs; 1 photograph. ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Ileocejunitis Involving the Entire Small Bowel. A. I. Friedman, Richard H. Marshak, and Harry Yarnis. *Am. J. Med.* 15: 741-745, November 1953.

Pathologic involvement in ileocejunitis is usually confined to the distal jejunum and the proximal ileum. In the 2 cases presented here, a diffuse stenosing ileocejunitis involved the entire small bowel. One patient had lived for ten years, despite an extensive pathologic condition. He eventually died of severe intestinal hemorrhage. The other patient was still alive at the time of the report, more than twelve years after onset of his progressively debilitating disease.

Diarrhea was a chief complaint but was never very distressing in either case. Loss of weight in both patients was marked—30 to 60 pounds. Fever developed late in the course of illness.

Four roentgenograms. HOWARD L. STEINBACH, M.D.
University of California

The Sprue Syndrome Secondary to Lymphoma of the Small Bowel. Marvin H. Sleisenger, Thomas P. Almy, and David P. Barr. *Am. J. Med.* 15: 666-674, November 1953.

Four cases of sprue secondary to histologically proved lymphoblastoma of the small intestine and mesenteric nodes are presented. The lesion was identified as lymphosarcoma in 2 instances, as reticulum sarcoma in the third, and as giant follicle lymphoma in the fourth. The 4 patients constitute 25 per cent of all cases of lymphosarcoma of the small intestine seen at the New York Hospital over a twenty-year period, and 16 per cent of all cases of non-tropical sprue.

A survey of the literature yielded 13 additional cases of sprue secondary to lymphoblastoma of the small intestine and mesenteric nodes.

The clinical features of these reported cases corresponded to the classic picture of non-tropical sprue. The history, physical findings, and laboratory data all pointed to serious deficiency of intestinal absorption. One patient had diarrhea, steatorrhea, nutritional anemia, hypoproteinemia, and a "deficiency pattern" of the small bowel on x-ray examination; she showed improvement of diarrhea and steatorrhea on a low-fat diet; on the other hand, the oral glucose tolerance test and blood calcium were normal.

Comparison of these cases with a series of 20 cases of idiopathic non-tropical sprue revealed that the average duration of symptoms was 6.9 months in the lymphoma group and 40 months in the "idiopathic" group. Otherwise, no differences were observed in the history, physical, x-ray or laboratory findings, or the short-term response to nutritive therapy. The authors doubt that the diagnosis of sprue due to lymphoblastoma of the small bowel can be made before obstruction or perforation of the bowel or dissemination of the disease.

Three roentgenograms; 2 tables.

HOWARD L. STEINBACH, M.D.
University of California

Radiology of the Small Intestine in the Dermatoses.

Thiers, Giraud, Buffard, Pinet, and Jacquemet. *J. de radiol. et d'électrol.* 34: 756-759, 1953. (In French)

In order to determine the status of the small bowel in various forms of dermatitis, 29 patients with eczema, 5 with pruritus ani, 6 with psoriasis, and 4 with cutaneous reticuloses were examined. In the group with eczema, 3 cases were excluded because the patients had undergone gastrectomy, and the chronic eczema had appeared after operation. Of the remaining 26 patients, 22 showed evidence of functional insufficiency of the small intestine. In all 5 of the patients with pruritus ani some change was found in the small intestine. No abnormalities were discovered in the 6 cases of psoriasis. Of the 4 patients with cutaneous reticuloses only 1 was found to be normal. Each of the other 3 had some sort of functional small bowel abnormality. No cases of scleroderma were available for study. The changes in all of these conditions appear to be non-specific, indicating a functional bowel derangement.

Seven roentgenograms. CHARLES M. NICE, M.D.
University of Minnesota

Volvulus of Cecum Due to Lithopedion. Bert A. Glass and Paul D. Abramson. *Am. J. Surg.* 86: 348-352, September 1953.

A 48-year-old colored female was admitted to Shreve-

port Charity Hospital complaining of generalized cramping abdominal pain which began six days earlier. The abdomen was distended, with clinical signs and symptoms of dehydration and obstruction. A flat roentgenogram showed multiple dilated loops of small intestine, chiefly in the epigastrium, and one large loop of greatly dilated large bowel in the lower abdomen. The upright film revealed fluid levels in the small bowel. At the level of the 5th lumbar vertebra, overlying the wing of the right ilium, was a calcified mass with the appearance of a mummified fetus of approximately four to five months gestation.

Following several days of conservative treatment with Miller-Abbott tube suction and restoration of the electrolyte balance, the patient was explored under spinal anesthesia. The cecum was found to be tremendously dilated, with a lesser degree of small intestinal distention. There were two areas of gangrene in the cecum. A calcified mass, approximately 10 X 8 cm., was palpated behind the ascending colon in the right colic gutter, 3 to 4 inches distal to the ileocecal valve. At this point the ascending colon was firmly attached to the retrocolic mass and the cecum had twisted in a counterclockwise direction, creating a closed loop obstruction which later had developed into a concomitant small bowel obstruction. Due to the patient's condition only a cecostomy was performed. At a second operation the cecostomy was closed and the abdomen explored. The calcified mass was found to be lying in the retroperitoneal position where it had apparently dissected following rupture of the right fallopian tube some time in the past. It weighed 200 gm. and contained bones of the extremities and what appeared to be the head of a calcified fetus. It was believed to be a true lithopedion.

The case was complicated further by atresia of the right main stem bronchus with either total atelectasis or congenital absence of the right lung, with a resultant marked shift of the mediastinum.

Three roentgenograms; 1 photograph; 1 drawing.

ALFRED O. MILLER, M.D.
Louisville, Ky.

Roentgenologic Examination of the Bleeding Bowel.

William M. Kitchen. *Am. J. Surg.* 86: 511-514, November 1953.

Bleeding from the bowel calls for an immediate and thorough investigation of the colon. The great majority of cases will be explained by the finding of anal or rectal disease. All cases require satisfactory digital, proctoscopic, and sigmoidoscopic study. The barium enema examination should not be minimized where bleeding is otherwise unexplained, but should not be expected to reveal rectal disease. Where blood streaking is noted as high as the sigmoidoscope can be passed, the surgeon will be justified in expecting a positive diagnosis from the radiologist in 95 per cent of cases. The remaining 5 per cent may be further reduced by stomach and small bowel studies and by investigation for systemic diseases such as leukemia.

In the roentgenologic study of the colon, the routine should embrace combined examinations. It is begun with a "scanning" enema, with finely divided barium powder in a thin suspension, affording optimum density and contrast. The colon is filled slowly and intermittently so that oblique viewing and spot-pressure fluoroscopy can be utilized. Ileal reflux should be avoided,

and the colon should not be overdistended. Following partial evacuation of barium, a double-contrast study is performed. Films are developed and studied before proceeding further.

A third filling of the colon is made with a thick barium mixture, and spot-pressure films are again obtained, with segmental examination of 3 inches of bowel at a time. Seventy-five per cent of the lesions in the author's series (120 cases of proved polypoid adenomas) were recorded diagnostically only by spot-film technic.

Where there is definite bleeding and all of the "routine" studies fail to reveal abnormality, all or a portion of the examination may be repeated.

Diverticulosis of the bowel should be accepted as a cause of bleeding with great hesitation. Carcinoma and adenoma are well known as occurring in conjunction with diverticula. Extrinsic pressure from diverticulitis may simulate an intraluminal lesion and, when carcinoma cannot be excluded, resection is justified.

The radiologist has an obligation to the patient to explain the films and to give reassurance when the study is negative. He must furnish the surgeon with the location of lesions, their multiplicity, size, configuration, and mobility.

A post-evacuation film for mucosal detail is apparently included but is not described in the "routine" study.

Six roentgenograms; 1 photograph; 2 tables.

JOHN F. RIESSER, M.D.
Springfield, Ohio

Polyps of the Rectum and Colon in Children. J. Wade Harris. *Am. J. Surg.* 86: 577-581, November 1953.

This article is concerned with a study of 70 children, aged one to twelve years, who were proved to have sessile or pedunculated polyps of glandular origin in the rectum or colon. The greatest number of lesions was observed in patients between the ages of one and six. Sex incidence was about equal.

The chief symptom was painless bleeding. The next most common was prolapse of a mass at the anus. Cramping abdominal pain is common if the polyp is in the sigmoid or above. Intussusception is unusual, but does occur. Nearly all polyps in children have the appearance histologically of very active glands. There were no malignant lesions in the author's series.

With a history of painless bleeding from the rectum in children, the examination should first be digital, then anoscopic and proctoscopic, preferably with an adult proctoscope. These examinations will suffice many times, but if the source of bleeding is not found, x-ray study of the colon is indicated. A double-contrast barium enema is necessary. Preparation must ensure a clean colon, and a strong laxative is indicated. Three ounces of castor oil is not too large a dose for a three or four year old child.

Auto-amputation of childhood polyps is apparently fairly common and may explain the lessened incidence after twelve years of age.

Two roentgenograms; 1 photomicrograph; 2 tables.

JOHN F. RIESSER, M.D.
Springfield, Ohio

Roentgen Appearances in Mechanical Rectal Constipation. Kristina Ekengren and Björn Snellman. *Acta radiol.* 40: 447-456, November 1953.

The subject of this study is rectal constipation, as

seen chiefly in females with clinical signs of mechanical interference with defecation. A characteristic complaint is that evacuation is incomplete because of an obstruction in the rectum.

Roentgen study of 30 patients was done with the use of barium sulfate given by mouth and per rectum and opacification of the vaginal canal with viscous Umbradil. Anteroposterior and lateral roentgenographic views were obtained with the patient sitting on a stool or special commode through which the evacuated barium could pass during straining while the film study was being done.

The significant findings were: (1) compression of the rectum by a lowering of the uterus during straining; (2) deep recto-genital pouch filled with small intestinal loops; (3) excessive anterior and/or lateral bulge of the rectum because of congenital or acquired weakness, brought about especially by straining, as with defecation.

WILLIAM SNOW, M.D.
Shreveport, La.

Acute Pancreatitis. H. S. Dolan and J. F. Hopkirk. *Canad. M. A. J.* 69: 495-503, November 1953.

Twenty-seven cases of acute pancreatitis are reviewed and a composite clinical picture of the disease is outlined. There were 2 deaths in the series, 1 among 12 cases in which laparotomy was performed and 1 among 15 patients treated without operation.

Etiological factors considered include: reflux of bile into the pancreas due to some abnormality of construction of the pancreatic ducts, with activation of pancreatic enzymes; obstruction in the pancreatic ductal system—edema, stone, spasm, or metaplasia; bacterial invasion of the pancreas via the blood, lymph, or bile; gallbladder disease.

Survey films of the abdomen early in acute pancreatitis will frequently show isolated distended loops of small bowel, usually with fluid levels, and most commonly situated in the upper mid-zone of the abdomen. Later, the picture seen is that of a marked paralytic ileus or peritonitis. Barium given by mouth may show upward displacement of the stomach, widening of the duodenal loop, and obliteration of the normal mucosal pattern of the duodenum.

The pancreas in acute hemorrhagic pancreatitis is enlarged and usually soft and friable, although it may be firm in the milder forms. Hemorrhage, edema, and necrosis of pancreatic tissue occur, either confined to the head or tail, or generalized. Yellow-white spots of fat necrosis occur on the surface of the pancreas or adjacent peritoneum and viscera.

Acute pancreatitis usually occurs in middle-aged, obese, over-indulgent males, although exceptions are frequent. Often there is a history of gallbladder dyspepsia and of a recent heavy meal or high alcohol intake. Onset of the disease is acute, with pain most marked in the mid or left epigastric region. In severe cases, extensive shock occurs. Vomiting is severe, as is dehydration. Abdominal tenderness, not usually marked, is maximum in the left epigastric region. Some epigastric rigidity is common, although less marked than in perforated peptic ulcer. No rectal tenderness occurs, which may also aid in distinguishing pancreatitis from a perforated ulcer.

Diagnosis is made from the signs and symptoms in the severe form, which are fairly typical. In the less severe condition laboratory confirmation is required.

Serum amylase and lipase and blood sugar are elevated, and the serum calcium is depressed. Serum bilirubin is slightly elevated. There are moderate leukocytosis and a raised hematocrit.

Differential diagnosis must take into consideration acute cholecystitis, perforated peptic ulcer, early intestinal obstruction, acute appendicitis, mesenteric thrombosis, acute gastritis, and coronary artery occlusion.

Treatment is discussed in some detail, the seven aspects of the authors' treatment plan including relief of pain, treatment of shock, treatment of dehydration, the prevention of autodigestion of the pancreas, the correction of secondary metabolic derangements, the prevention of secondary infection, and the removal of the gallbladder. The authors are not in favor of cholecystectomy or laparotomy during the acute phase of the disease unless the diagnosis is seriously in doubt.

Two roentgenograms; 6 charts.

WARREN A. NAFIS, M.D.
Jefferson Medical College

Carcinoma of the Biliary Tract. Ira S. Goldenberg. *Am. J. Surg.* 86: 292-300, September 1953.

Carcinomas of the biliary tract comprise primary carcinoma of the liver, carcinoma of the gallbladder, and carcinoma of the extrahepatic bile ducts. Carcinoma of the biliary tract presents symptoms relatively late in the development of the tumor, so that longevity after symptoms appear is universally brief. No satisfactory method has yet been devised to screen asymptomatic patients and there is still no method of diagnosis of the early lesion. Radical surgery, even in patients whose lesions appear to be early and easily resectable, has not yet produced many long-term cures.

Carcinoma of the liver is primarily a disease of elderly males. The most common presenting symptoms in the author's series of 27 cases were weight loss, abdominal pain, and jaundice. Gastrointestinal symptoms such as dyspepsia, nausea, and vomiting were present in about one-third of the cases. Upper gastrointestinal x-ray examinations were made in 15 patients. In 12 of these the findings were interpreted as abnormal, and in 5 the possibility of cancer was suggested by extrinsic pressure defects on the stomach or duodenum. Cholecystograms were made on 9 patients, and a normal gallbladder was demonstrated in 6 of these.

Carcinoma of the gallbladder occurs chiefly in women; 80 per cent of the patients in this series were females. The incidence of cholelithiasis in carcinoma of the gallbladder is certainly higher than in the general population, and it may be an important factor. Like primary liver carcinoma, cancer of the gallbladder gives its first clinical signs and symptoms late in the course of the disease. Forty-three per cent of the author's 30 patients had cholelithiasis and 37 per cent had chronic cholecystitis. Cholecystograms were obtained in 8 cases and all were reported as abnormal, but the possibility of a malignant tumor was not mentioned. In 18 of the patients upper gastrointestinal studies were performed, and in 13 of these the findings were interpreted as abnormal. In 11 there was suggestive evidence of malignant disease (constriction of the second portion of the duodenum or extrinsic pressure defect on the duodenum).

Carcinoma of the extrahepatic bile ducts closely resembles cancer of the gallbladder. The chief difference is the relatively early appearance of symptoms in most

cases. Despite the early symptomatology, however, surgical extirpation of the lesion with resultant cure is rare because of the anatomy in this area. Determination of the precise site of origin of the malignant process is more difficult than elsewhere in the biliary tract. Even a small carcinoma invades the area so completely that it is impossible to determine whether the tumor has arisen from the bile ducts, the ampulla of Vater, or the head of the pancreas. In the present series only those cancers definitely proved to be of bile duct origin (excluding the ampulla of Vater) are included. They numbered 33.

A history of chronic disease of the gallbladder is uncommon in patients with cancer of the extrahepatic bile ducts. Most commonly there is a rapid onset of fulminating symptoms consisting of jaundice, dyspepsia, abdominal pain, and weight loss. Roentgenography has been somewhat more valuable in diagnosis of this condition. Seventeen of 27 upper gastrointestinal studies were reported as showing a lesion in the second portion of the duodenum or other masses deforming the duodenum, probably of malignant origin. All of the films, however, were of patients with far advanced carcinoma.

Four tables.

ALFRED O. MILLER, M.D.
Louisville, Ky.

Evaluation of Pseudoalbuminuria Following Cholecystography in Seventy-six Cases. J. E. Holoubek, W. H. Carroll, G. M. Riley, and R. B. Langford. *J.A.M.A.* 153: 1018, Nov. 14, 1953.

Cholecystography is now carried out principally by use of oral iodopanoic acid (Telepaque), which contains 66.68 per cent iodine, and iodoaliphonic acid (Priodax), which contains 51.38 per cent iodine. Both are excreted mainly by the kidneys. Their use is contraindicated in acute nephritis and uremia.

Because of reports of transient albuminuria in experimental animals and false positive tests for albumin following the use of iodoaliphonic acid, the authors studied 76 patients who had been given either Priodax or Telepaque for visualization of the gallbladder. On the day of cholecystography, 40, or 52.6 per cent, were negative for albumin; 36, or 47.4 per cent, had a positive reaction, varying from a trace to 4 plus. In a recheck three days later, all tests were negative, and follow-up studies revealed no kidney disease. There was no difference between Priodax and Telepaque in this respect. With the heat and acid test for albumin detection in urine, this false positive reaction will be avoided.

It is the actual presence of iodoaliphonic or iodopanoic acid in the urine that causes the pseudoalbuminuria, and this should not be attributed to renal irritation due to the drug or to renal disease.

JOHN P. FOTOPoulos, M.D.
University of Michigan Hospital

THE MUSCULOSKELETAL SYSTEM

Osteitis Deformans with Spinal Cord Compression. Report of Three Cases. F. R. Latimer, J. E. Webster, and E. S. Gurdjian. *J. Neurosurg.* 10: 583-589, November 1953.

The authors present 3 cases of spinal cord compression due to osteitis deformans. They also review the literature and discuss the findings in 22 other cases in which they consider the diagnosis to be definite.

The syndrome, in the 25 cases analyzed, was usually seen in men in the fourth through the sixth decade. Spinal cord compression occurred slowly but progressively. The initial complaint in most instances was impairment of sensation. Paresthesias occurred in the lower extremities, and pain was frequent, beginning in the back and later radiating into the lower extremities. Disturbances of gait became apparent as the disease progressed. Laboratory studies showed elevation of spinal fluid protein and of the serum alkaline phosphatase.

Spinal cord compression did not occur in the monostotic form of osteitis deformans but only when two or more adjacent vertebral segments were involved, with or without compression fractures. Most patients were considered to have advanced disease. Myelography showed complete block of the subarachnoid space at the level of the lesion, which was nearly always in the mid-dorsal area. This predilection may be due to the fact that the interpedicular space is narrowest in the thoracic region.

Decompression laminectomy can be expected to give relief from symptoms. Severity of neurologic deficit should not be regarded as a reliable guide as to the ultimate benefit that may be derived from surgery. In 2 of the authors' 3 cases the results of decompression were gratifying.

Three roentgenograms; 2 photomicrographs.

JOHN J. CRAVEN, M.D.
Cleveland Clinic

Leontiasis Ossea, Slipped Epiphyses, and Granulosa Cell Tumor of Testis with Renal Disease. Report of a Case with Autopsy Findings. Jonathan Cohen and Israel Diamond. *Arch. Path.* 56: 488-500, November 1953.

Leontiasis ossea secondary to renal disease and granulosa-cell tumor of the testis are two lesions which hitherto have not been reported. These two lesions were encountered by the authors in a single patient, a 21-year-old man who died in uremia.

The patient presented the following principal pathological lesions: hypoplastic kidneys; chronic pyelonephrosis; leontiasis ossea; hyperparathyroidism; slipped epiphyses of the hips and shoulders; osteitis fibrosa secondary to renal disease; granulosa-cell tumor of the testis; congenital megaloureter and hydronephrosis possibly secondary to ganglion cell deficiency; coarctation of the aorta. A seven-year study of his clinical course and the serum electrolyte pattern is summarized.

This case is reported in detail because several features of it suggest a possible interrelation between the kidneys and endocrine secretions. One may suspect that some of the bone changes are not due solely to the effects of increased parathyroid activity and alteration of the serum electrolytes, but also to the increased action of estrogens. A second speculation is concerned with the relationship between prolonged renal insufficiency and the elaboration of a testicular tumor. It is possible that the reduced renal elimination of pituitary gonadotropic hormone, particularly during the changes incident to puberty, may be significant etiologically, even as reduced inactivation of estrogens occurs in liver disease.

Four roentgenograms; 9 photomicrographs; 1 photograph.

THEODORE E. KEATS, M.D.
University of California

A Case of Klippel-Trenaunay Syndrome. M. L. García García. *Rev. cubana pediat.* 25: 616-628, October 1953.

Since the first publication on the syndrome with which this paper deals, by Trelat and Monod in 1869, various names have been applied to it. Klippel and Trenaunay in France called it an osteohypertrophic varicose nevus. In Germany it was termed *phlebectasia* and *Phlebectasia genuina*. In England it was called *haemangiectasia osteohypertrophica*. The French authors considered the nevus to be the initial pathological manifestation with secondary hypertrophy of the limb and phlebectasia. This simple and logical interpretation has been adopted by many; Bode believes that the vascular nevi functioned as true arteriovenous communications. However, the question has not been finally resolved, as the theories of association with the diseases known by the designation of Recklinghausen and of Sturge-Weber-Krabbe cannot be disregarded.

The case reported involved a child of eight years showing red blotches on the trunk, venous angiomas of both arms, one of them bleeding, and an enlargement of the left leg. The left hip joint was slightly higher than the right. The roentgen studies showed no remarkable change in the osseous texture, other than the enlargement, although cases have been reported with thickening of the periosteum and advanced osteoporosis. The hypertrophy of the soft parts occurs at the expense of the muscles, connective tissue, and fat. Parkes Weber considered that the hypertrophy was due to an alteration of the sympathetic nervous system.

JAMES T. CASE, M.D.
Santa Barbara, Calif.

Multiple Metaphyseal Fractures in Small Children. (Metaphyseal Fragility of Bone.) R. Astley. *Brit. J. Radiol.* 26: 577-583, November 1953.

In this interesting paper, the author presents case histories of 6 children under two years of age with multiple metaphyseal fractures without evidence of adequate trauma. The children were apparently well and there was remarkably little pain or other general disturbance. Most of the fractures were not detected clinically. The ribs were most commonly fractured, followed by the clavicle, femur, tibia, and spine. Union occurred normally.

No indication of the etiology was found. The dietary histories were good. Biochemical studies showed no abnormalities. Rickets, scurvy and syphilis were all eliminated.

Six roentgenograms. SYDNEY J. HAWLEY, M.D.
Seattle, Wash.

Cleido-Cranial Dysostosis. E. C. Paulson and Norman Sterrie. *Minnesota Med.* 36: 1152-1153, November 1953.

A family history covering four generations is presented to indicate the hereditary nature of cleidocranial dysostosis. The authors' patient was a young woman of the third generation with absence of clavicles, a palpable defect at the site of the anterior fontanel, frontal bosses, and faulty development of the pelvic bones. Similar changes were observed in her two children.

Six roentgenograms; 1 chart.

Congenital Kyphosis. A. C. Bingold. *J. Bone & Joint Surg.* 35-B: 579-583, November 1953.

Three cases of congenital kyphosis are reported and

the literature is reviewed. It is important to differentiate this condition from the kyphosis associated with tuberculosis of the spine. In congenital kyphosis there is invariably developmental abnormality of one or more vertebral bodies, most commonly between the tenth thoracic and second lumbar segments. The defect in development may result in absence of the vertebral body, microspandy of one or more vertebrae, or a combination of these conditions; absence of a corner of a vertebral body; incomplete segmentation of several neighboring vertebrae; or wedging of the vertebra anteriorly. Tuberculosis of the spine can be excluded by the absence of intervertebral disk involvement, destruction of bone, a paravertebral abscess shadow, and other systemic manifestations of tuberculosis. Treatment is briefly discussed.

Eleven illustrations, including 3 roentgenograms.

MAURICE TATELMAN, M.D.
Detroit, Mich.

Ewing's Tumour of the Clavicle. K. S. Bose and N. M. Banerjee. *J. Indian M. A.* 23: 68-69, November 1953.

A case of Ewing's tumor involving the clavicle is reported. The original roentgen examination showed slight osteomyelitic changes in the outer end of the clavicle, in the form of destruction and granular new bone formation. Three weeks later a further roentgen study revealed the typical onion-skin appearance of Ewing's sarcoma, and a biopsy diagnosis was made. Deep x-ray therapy was given—for a total tumor dose of 3,572 r in nineteen treatments in three weeks—and was followed by complete regression of the tumor. The patient remained free of recurrence for sixteen months. At the end of that time there was slight swelling at the original tumor site with pain. These disappeared after further irradiation (a tumor dose of 1,800 r in twelve days). The patient is still under observation.

One roentgenogram.

Tuberculosis of the Elbow. A Study of Thirty-One Cases. J. N. Wilson. *J. Bone & Joint Surg.* 35-B: 551-560, November 1953.

The author reviews 31 cases of tuberculosis of the elbow, which he divides into four groups radiologically:

1. *The Synovial Lesion:* Radiographs show no specific change except for generalized osteoporosis, and there is no particular destruction of the joint space.

2. *The Extra-articular Lesion:* Destruction was seen in the olecranon and in the condylar regions of the humerus in 6 cases, some of them with multiple areas of involvement. The joint space is narrowed.

3. *The Coronoid Lesion:* This lesion was seen in 8 cases, manifested by rather irregular destruction, extending slightly into the olecranon.

4. *The Massive Lesion:* This was the most common radiological appearance, occurring in 13 cases (40 per cent). Since the coronoid area was always involved in these cases, the author postulates that the earliest focus may have been of the coronoid type. There is frequently a posterior subluxation or even complete posterior dislocation of the radius. The prognosis for mobility of the elbow is extremely poor in these cases.

Methods of treatment are discussed, with emphasis upon conservative measures, including streptomycin therapy and immobilization. Operative intervention may be useful in extra-articular cases. Three cases of

massive joint involvement showed satisfactory ankylosis without surgical treatment, but it was noted that some degree of rotation was still present because the radiohumeral joint had not fused.

Twenty-two roentgenograms; 5 tables.

MAURICE TATELMAN, M.D.
Detroit, Mich.

Fractures of the Carpal Navicular. Accurate Diagnosis and Planned Treatment. Edward C. Branson. *New England J. Med.* 249: 884-886, Nov. 26, 1953.

Almost all navicular fractures can be seen on either an anteroposterior or an ulna oblique view of the wrist. In a series of 32 fractures, only 2 were not demonstrable at the time of injury, and these were apparent four weeks later, after beginning calcium absorption.

Practically all navicular fractures will heal with adequate immobilization, i.e., immediate complete immobilization until roentgenographic demonstration of union as indicated by actual visualization of bone trabeculae crossing the fracture line. In the present series of 32 cases, 30 healed: 25 per cent in less than four months, 56 per cent in four to six months; the remainder required over six months.

A roentgenogram is made routinely two weeks after removal of the cast. If the fracture has become more evident, recasting is indicated. Increased density or cystic changes in the proximal fragment indicate aseptic necrosis. In such cases immobilization must be continued until healing of the aseptic necrosis is complete.

Three roentgenograms.

RICHARD E. BUENGER, M.D.
Chicago, Ill.

Ossifying Fibrosarcoma (Extraskeletal Osteogenic Sarcoma) of Thigh Muscle. Report of a Case with Recurrence and Widespread Metastases More than Four and a Half Years After Excision. William Umiker and Henry L. Jaffe. *Ann. Surg.* 138: 795-800, November 1953.

A case is reported in which a neoplasm arising in the thigh muscles was first considered to be a cellular fibromatous tumor of doubtful malignancy, although some bone formation was seen in the original operative specimen. Four years later two large, densely calcified metastatic lesions were removed from the left lung. These masses showed much variety in cellular structure—fibrous tissue, cartilage, and bone. There had been no local recurrence or any other sign of metastasis to this time. Within a few months a recurrence at the original tumor site in the thigh was found and excised, but more generalized metastases rapidly developed and death ensued at the age of forty-three.

Extraskeletal osteogenic sarcoma is very rare, but the present case furnishes proof that mesenchymal cells which can differentiate into neoplastic fibroblasts (fibrosarcoma) can also differentiate into neoplastic chondroblasts and osteoblasts.

Three roentgenograms; 13 photomicrographs; 2 photographs.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Development of Congenital Dislocation of the Hip. E. W. Somerville. *J. Bone & Joint Surg.* 35-B: 568-577, November 1953.

On the basis of observations by others and a personal study of 35 cases in which open reduction was done, the

author seeks to explain the development of typical congenital hip dislocation. An important finding in all the hips explored for complete dislocation, and demonstrable also by arthrography, was inversion of the lip or limbus of the cartilaginous acetabulum into the joint on its posterosuperior surface. In view of this observation, along with the anterior and superior dislocation of the femur and the fact that anteversion of the upper end of the femur is consistently present, a quite reasonable mechanism for the production of congenital dislocation is postulated.

It is suggested that, because of the normal anteversion present in the upper end of the femur in the fetus, the thigh must go into either medial rotation or abduction, or both, whenever the hip is extended; otherwise, a considerable strain will occur on the anterior capsule of the joint allowing subluxation and later dislocation. Normally the upper end of the femur will gradually mold under the intermittent pressure of extension to produce a normal hip. In other cases the anterior capsule stretches, allowing for subluxation anteriorly and superiorly and later, with further strain, actual dislocation results. For these reasons, the author suggests that for early correction of subluxation or dislocation, the hip may be pulled down into normal position in the acetabulum and placed in abduction; following this, removal of the inverted limbus may be accomplished and a rotation osteotomy done to correct the anteversion.

Roentgenograms and line drawings further clarify the findings and hypotheses of the author.

Seven roentgenograms; 1 photograph; 2 drawings.

MAURICE TATELMAN, M.D.

Detroit, Mich.

Osteoarthritis of the Hip: A Study of the Nature and Evolution of the Disease. M. H. M. Harrison, F. Schajowicz, and J. Trueta. *J. Bone & Joint Surg.* 35-B: 598-626, November 1953.

The authors have attempted to clarify the confusing status of the pathogenesis of osteoarthritis, choosing investigation of the hip because of the frequency with which this condition occurs in that joint. Their investigation is based upon 91 postmortem examinations of the hip, study of 45 femoral heads removed surgically for osteoarthritis of the hip, and radiographs obtained from 80 cases of osteoarthritis of the hip which were followed over a period of several years. The article contains a detailed and excellent discussion, well illustrated, of the findings on macroscopic observations, roentgenologic features, histologic findings, and vascular changes as disclosed by injection technic.

Because of the location of the arthritic changes and the manner in which they develop, the authors conclude that the cartilage degeneration actually occurs because of inadequate use, since the point of maximum pressure and weight-bearing on the femoral head is the last to show such changes. The intermittent pressure of normal use on the weight-bearing portion of the head is believed to be actually beneficial to cartilage, rather than harmful. The authors' observations tend also to refute the theory that the changes are on the basis of decreased vascularity, since increased vascularity was consistently found at the points of active change, even in the early stages of the disease. The increased vascularity leads to an attempt at repair of the degenerative cartilage, which aggravates the dis-

turbance in the joint surface both by formation of new bone, represented by osteophytes, and also by weakening the structure of the bone generally because of demineralization, so that subsequent changes, including flattening and impaction of the femoral head, may occur. These latter changes tend to result in further attempt at repair, which produces a cycle of similar abnormal changes.

The role of the so-called cysts accompanying osteoarthritis is also stressed. It was found that these invariably occurred in the upper portion of the segment of the femoral head, where maximum weight-bearing pressure occurs. It was further noted that these radiolucent areas tend to show communication with the joint space (see following abstract). The mechanism of the production of the cysts is not, however, indicated.

Although there may be some grounds for disagreement with some of the conclusions reached, the entire presentation in this article is excellent and well documented. It represents a significant forward step in understanding of the pathogenesis and natural history of osteoarthritis, particularly as it occurs in the hip.

Fifty-six illustrations, including 19 roentgenograms and 31 photomicrographs.

MAURICE TATELMAN, M.D.

Detroit, Mich.

The Bone Cysts of Osteoarthritis. J. W. Landells. *J. Bone & Joint Surg.* 35-B: 643-649, November 1953.

A consideration of the nature of the so-called bone cysts of osteoarthritis leads the author to an hypothesis as to the mechanism of their formation which is at variance with some of the older concepts of their origin. Microscopic examination of femoral heads excised for osteoarthritis and also findings in several other bones have shown that the cysts are frequently piriform in configuration and always lie immediately adjacent to the joint space.

By sectioning in various planes the author has been able to find evidence of a patent communication of the neck of the cyst with the joint space in a number of cases. In other instances, in which the cyst does not appear to be communicating with the joint, there appears to be a plug of either fibrous tissue or newly formed cartilage or bone occluding the opening. These points are well illustrated by photomicrographs.

Fluid found in the cysts is similar in appearance and staining reactions to synovial fluid. In the cases in which the cyst opening has been occluded, the presence of granulation tissue or fibromyxomatous tissue in the cyst is explained as secondary to fluid formation. In some cases this material actually becomes cartilaginous or even partially ossified.

The author advances very plausible arguments for the theory that the cyst is formed by intrusion of synovial fluid into the bone following a slight break in the covering cartilage surface and also a very valid objection to the alternative possibility that these cysts may have been formed secondary to primary necrosis or ischemia within the bone, followed by fibrosis and secondary fluid accumulation.

This article deserves careful consideration as a more logical explanation of the cystic changes in osteoarthritis than has previously been held.

Seven photomicrographs.

MAURICE TATELMAN, M.D.

Detroit, Mich.

The Role of Capsular Changes in Osteoarthritis of the Hip Joint. G. C. Lloyd-Roberts. *J. Bone & Joint Surg.* 35-B: 627-642, November 1953.

The author reports observations based upon a gross and histologic study of 25 osteoarthritic hips subjected to arthroplasty or arthrodesis, as well as gross and microscopic examination of the hip joint in 7 cadavers. The entire synovial membrane of an osteoarthritic hip is congested and unduly villous for the patient's age. Intra-articular adhesions are often conspicuous and may fill the joint to such an extent that difficulty is encountered in defining its cavity, the capsule surrounding the neck like a tight collar. More typically, however, the capsule is thickened and shortened and lacks normal pliability. Progressive fibrosis of both the synovial membrane and the capsule occurs. Cartilage and bone debris have been found beneath the synovial surface in many of these cases and the author feels that the fibrosis is the result of synovial hyperplasia which accompanies the phagocytosis of this fragmented material. Similar changes were produced experimentally by injection of fragmented cartilage into the knee joint of rabbits.

In an attempt to correlate the above findings with the clinical picture, it is postulated that the pain in osteoarthritic joints may be due in large part to attempts to stretch the fibrotic and shortened capsule by movement. By the same line of reasoning, lack of pain in many osteoarthritic joints, especially in older people, is attributed to a voluntary or gradual restriction of activity of the joint so that the capsule is not stretched. The author also points out that, because of the capsular fibrosis and subsequent pain, there is associated muscle spasm, full extension of the hip is lost, and consequently weight is borne by a progressively smaller portion of the articular cartilage since the maximum contact is obtained in full extension. This tends to aggravate the changes, since there is therefore a more rapid wearing out of the articular cartilage on the smaller weight-bearing surface.

Mention is made of a radiological sign of capsular shortening, namely, new bone formation visible below the femoral neck. This has been regarded as a buttress formed in response to abnormal stress. It was present in 33 of 73 consecutive patients with osteoarthritis of unknown origin undergoing operation.

Four roentgenograms; 11 photomicrographs.

MAURICE TATELMAN, M.D.
Detroit, Mich.

Arthrography of the Knee by the Double-Contrast Method. G. Candardjis and F. Saegesser. *Radiol. clin.* 22: 521-528, November 1953. (In French)

In general, surgeons feel that arthrography adds little to the clinical diagnosis of knee conditions, claiming that those cases wherein it does give information are readily diagnosable clinically, while those obscure clinically remain so after arthrography.

For proper utilization of the procedure, two things are necessary: (1) thorough knowledge of the complex internal anatomy of the knee, with corresponding knowledge of the roentgen anatomy, and (2) an exacting technic, with strict collaboration between radiologist and surgeon. Anteroposterior and lateral views must be supplemented by oblique projections. Even so, some meniscus lesions will elude discovery, as for example a transverse tear through the internal meniscus. Fortunately such tears are practically always associated with a longitudinal cleavage which is discernible.

The authors use 6 to 8 c.c. of opaque medium injected with 60 to 80 c.c. of air. The femoral condyles, menisci, and tibial plateaus are separated by leg traction combined with abduction or adduction according to whether the internal or external meniscus is being examined. Since good muscular relaxation is necessary, the air injection is discontinued when pain is produced. The needle (which should be fine) is then withdrawn and good distribution of the mixture is obtained with active and passive motion. The patient is then turned prone and, after radioscopy, the proper projections are chosen to demonstrate each meniscus. Six films comprise a routine, proceeding from the left to the right lateral decubitus. Radioscopy is depended upon to show the cruciate ligaments. The axial view is used to demonstrate the patellar cartilage. The posterior cruciate ligament is not always well visualized, being in part extra-articular. Fortunately, it is seldom the site of traumatic lesions and, when these do occur, they are usually associated with a small avulsion fracture at its tibial insertion. The early stages of chondromalacia patellae, when still localized at its inferior angle, are also poorly defined: the axial view fails because of the concavity of its posterior surface, and the lateral view because of interference from the attachment of the ligamentum mucosum. In spite of these two exceptions, double-contrast arthrography is to be considered an important advance in the diagnosis of alterations within the knee.

The articular reaction is variable but generally minimal. Because of rapid absorption (15 to 20 minutes) of the medium, rapid examination is necessary.

Five roentgenograms; 3 diagrams.

CHRISTIAN V. CIMMINO, M.D.
Fredericksburg, Va.

Concerning the Worth of Pneumoarthrography of the Knee Joint. H. J. Nidecker. *Radiol. clin.* 22: 518-521, November 1953. (In German)

In the past there have been two opposing methods of arthrography: double-contrast and positive-contrast. The author believes that the value of the procedure lies not so much in the contrast method employed, but rather in the care observed in using the chosen technic. His own method has been described previously (*Radiol. clin.* 22: 10, 1953. *Abst. in Radiology* 61: 855, 1953).

Of 53 patients who underwent arthroscopy without pneumoarthrography, 7 (13.2 per cent) had negative operative findings. Twenty-seven underwent surgery after pneumoarthrography, and 2 (or 7.4 per cent) had negative operative findings. [The difference between these two percentages is not statistically significant, being even less than one sigma.—C. V. C.]

Three roentgenograms; 2 tables.

CHRISTIAN V. CIMMINO, M.D.
Fredericksburg, Va.

Arthrography of the Knee Joint with Positive Contrast Method. K. Schärer. *Radiol. clin.* 22: 528-529, November 1953. (In German)

This author believes that positive contrast studies with a water-soluble medium give the most reliable results in arthrography of the knee. Over 90 per cent correct diagnoses were obtained in a series of cases which were considered difficult problems clinically. In a series of more than 100 cases, no untoward reactions of

significance were encountered. There should be no need, however, to subject the patient to this costly examination when the diagnosis is clear on clinical grounds.

After the usual knee tap, 10 c.c. of a water-soluble substance (35 to 50 per cent) is injected, special care being taken to exclude air from the joint. The following films are then taken: anteroposterior, anteroposterior with outward rotation, anteroposterior with inward rotation, postero-anterior, and medial lateral. Stereoscopic pairs are advisable because of the confusing superimposed shadows of the contrast medium in bur-sae and recesses. CHRISTIAN V. CIMMINO, M.D.
Fredericksburg, Va.

THE GENITOURINARY SYSTEM

Thoracic Renal Ectopia. H. Stephen Weens and M. Harlan Johnston. *Am. J. Roentgenol.* 70: 793-796, November 1953.

The authors report a case of high renal ectopia, with the kidney presenting through the foramen of Bochdalek, in a man of thirty-three years. Roentgen examination disclosed a broad-based thoracic mass adjacent to the posteromedial portion of the diaphragm, regressing slightly on expiration and becoming more prominent on inspiration. Retrograde pyelography confirmed the diagnosis of high renal ectopia, showing the upper pole of the kidney to be above the level of the diaphragm.

Pathologically, in addition to the anomalous position of the kidney, high renal ectopia includes an abnormal ureteral length, an anomalous blood supply, and a failure of medial rotation. Except for occasional traumatic herniation of the kidney through the diaphragm, renal ectopia of this type is nearly always congenital and may be associated with other congenital defects of the genitourinary system, as was true of the case reported here.

In obtaining pyelograms in such cases, the authors advocate that the central ray pass through the level of the diaphragm in both the anteroposterior and lateral projections in order to obtain an undistorted view of the relationship of the kidney and diaphragm. This is of importance for differentiation from other thoracic masses.

Three roentgenograms.

ROBERT H. LEAMING, M.D.
Memorial Center, New York

Sextuplicitas Renum: A Case of Six Functioning Kidneys and Ureters in an Adult Female. R. Campbell Begg. *J. Urol.* 70: 686-693, November 1953.

The report of 6 functioning renal structures in one person is startling. That the patient was a 42-year old mother with two children, enjoying excellent health, adds significance. Attempts to explain the finding embryologically are made in this article but prove to be inconclusive.

Urograms showed a left medial group of two kidneys and a right medial kidney. These three kidneys are not unusual and if the anomaly stopped there, it would represent simply a double kidney with two ureters on one side. In addition, however, there were lateral groups consisting of a single kidney on the right and two kidney units on the left. The ureters of the lateral groups passed out widely, coursing far lateral to the normal ureters. They originated from a series of tubelike calyces which passed mediolaterally, in contrast to

the usual arrangement as seen in the medial group. At their lower ends these lateral ureters turned sharply toward the middle line, crossed the medial ureters, and seemed to be coursing toward the region of the bladder neck.

Uroselectan was used as the contrast medium. The medial three kidneys concentrated most of the contrast substance. The shadows of the lateral ureters were less dense and were not visible after the ten-minute film.

Two roentgenograms; 1 drawing.

DONALD DEF. BAUER, M.D.
Coos Bay, Ore.

Delayed Cystograms in Children. Raymond G. Bunge. *J. Urol.* 70: 729-732, November 1953.

In all children suspected of having urological disease in whom routine excretory pyelograms are unrevealing, the author obtains delayed cystograms. Skiodan is instilled into the bladder by catheter. A feeling of fullness is the principal guide in determining the amount (75-100 ml. of 10 per cent solution). The patient is allowed to walk around, and exposures are made thirty and sixty minutes after the instillation.

Five normal children, from three to eighteen years of age, were examined by this method and no ureteral reflux appeared. Observations are also presented in 6 cases with reflux due to such conditions as urinary tract infection, congenital bladder neck obstruction, and neurogenic bladder.

The damaging effect of ureteral reflux upon the kidney by pressure and infection is well known and the consequences of failing to recognize it are serious. Perhaps the most help from delayed cystograms is obtained in the case with recurrent urinary tract infection, unexplained after repeated excretory pyelograms and other studies.

Six roentgenograms; 1 table.

DONALD DEF. BAUER, M.D.
Coos Bay, Ore.

Significance of Ureteral Studies in Colonic and Rectal Surgery. Harry E. Bacon, Edward J. Lowell, Jr., and Howard D. Trimpi. *Am. J. Surg.* 86: 572-575, November 1953.

Anatomic relations of the ureters may be significantly altered by specific disease processes and previous surgery affecting the colon and the rectum. These altered relations may be more readily seen by preoperative x-ray study with catheters in the ureters, and the findings may be of value in deciding upon the type of surgery required for a specific lesion, especially where the need for a radical approach might not otherwise be anticipated.

The authors have analyzed the information obtained from ureteral roentgenograms as an adjunct to the surgical management of 86 patients with distal colonic and rectal disease. Patients ranged in age from thirty-one to seventy-six years, averaging 53.9 years. Sex distribution was essentially equal. Sixty-six patients had carcinoma of the colon, 7 had diverticulitis, and 6 had adenomatous polyps above the peritoneal reflection; the other cases included chronic ulcerative colitis, stricture due to lymphopathia venereum, and radiation proctitis.

In 50 of the 86 patients (58.1 per cent) the ureters were bilaterally normal in position, course, and sym-

metry. In 14 patients (16.4 per cent) failure of visualization of one ureter following attempted bilateral catheterization indicated a possible unilateral abnormality, but in only 2 patients (2.3 per cent) was there correlation with actual disease. In 22 patients (25.6 per cent) a symmetry or deviation of the ureter was indicated by bilaterally successful ureteral catheterization preoperatively and this was correlated with actual disease at time of surgery in 10 (11.7 per cent). Of these 10, 5 were found to have associated pathologic disease classifying the patient as probably incurable; the remaining 5 underwent surgery of sufficient extent to promise some hope of eradication of the disease.

Medial deviation of the ureters, as demonstrated in preoperative films, is frequently associated with serious pathologic changes. It may indicate an unfavorable prognostic sign of extensive intra- and extracolonic disease. The authors advocate routine preoperative pyelograms and ureteral studies as a valuable adjunct to improved surgical management of colonic and rectal lesions.

Two roentgenograms. JOHN F. RIESSER, M.D.
Springfield, Ohio

Nephrogram Following Acute Myocardial Infarction. Hyman Peck. *California Med.* 79: 405-406, November 1953.

A decrease in systolic blood pressure from any cause results in stoppage of glomerular filtration but tubular flow continues. When the blood pressure fall coincides with an injection of a pyelographic medium, a nephrogram may result.

In the present case, fall in blood pressure was caused by an acute myocardial infarction, which from the facts presented must be assumed to have been precipitated by injection of Diodrast (20 c.c., 35 per cent). Admittedly the evidence is circumstantial, and mere coincidence is also possible. Serial films at five, ten, fifteen, and twenty-five minutes showed renal opacification, with only a minimal amount of medium in the urinary bladder and none in the calyces and pelves.

Two roentgenograms. ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Coronary Insufficiency Following Intravenous Pyelography. Carl C. Epstein. *California Med.* 79: 406-408, November 1953.

Reactions to intravenous pyelography have generally been considered as anaphylactic or toxic. In the case reported here, injection of 20 c.c. of 75 per cent Neoipax for this purpose was followed by pain in the chest and electrocardiographic evidence of coronary insufficiency. Clinical study had indicated that the patient had some type of chronic nephritis. A urine concentration test had shown a fixed specific gravity of 1.010, and blood urea nitrogen was elevated. The films were unsatisfactory because of inadequate concentration of the contrast medium [as was to be expected]. Electrocardiograms done before the injection showed some evidence of myocardial disease of the lateral wall.

[It may be that the coronary episode would have occurred without the injection, but in view of this report and that abstracted above, from the same journal, one wonders if more such cases may have occurred and been considered as unrelated to the diagnostic procedure.]

One electrocardiogram. ZAC F. ENDRESS, M.D.
Pontiac, Mich.

MISCELLANEOUS

Emergencies in the Newborn. George Cooper, Jr., McLenore Birdsong, and Randolph Bradshaw. *J.A.M.A.* 153: 1077-1080, Nov. 21, 1953.

The decline in death rate during the first month of life, as well as the first day, has not kept pace with the decline in the period from the second to the twelfth month. With this fact in mind the authors have discussed a group of emergencies in the newborn in which the combined efforts of the radiologist, pediatrician, and surgeon may be effective in decreasing mortality.

A. Respiratory and Circulatory Embarrassment:

1. **Pulmonary Maldevelopment:** Compatible with life if initial respiratory embarrassment is overcome. Roentgen examination, including bronchography useful.

2. **Atelectasis:** Some non-aeration is physiologic in first few days in full-term infants and in the first four to six weeks in the premature. Differentiation from obstructive atelectasis is most important prognostically.

3. **Pulmonary Hyaline Membrane Syndrome:** Meschan *et al.* (*Radiology* 60: 383, 1953) pointed out that the initial phase of this syndrome presents a unique combination of dyspnea and asphyxia, with roentgenograms showing good pulmonary aeration. This is followed by improvement of symptoms and clouding of the lung fields. Laryngoscopy is contraindicated. Treatment should be with high oxygen concentration, mist, and antibiotics. Babies brought safely through the first four days of life usually survive.

4. **Positive Pressure Pneumothorax and High-Tension Cysts:** Localized obstructive emphysema is the most frequent cause of either rupture of the visceral pleura or passage of air along perivascular spaces into the mediastinum. Roentgen diagnosis avoids unnecessary bronchoscopy, and relief of positive pressure pneumothorax is often life-saving.

5. **High-Tension Cysts:** Several cases are cited in which radiological demonstration of the cystic spaces and mediastinal shift led to prompt surgical intervention and recovery.

6. **Diaphragmatic Hernia:** Unless corrected promptly, this is apt to cause death due to intestinal obstruction and aspiration pneumonia. If surgical repair is delayed for a long interval, underdevelopment of the abdominal cavity may result, making later reduction difficult.

B. **Abdominal Mass:** The finding of an abdominal mass other than an enlarged liver or spleen is an emergency in the newborn as well as in older infants. A soft or cystic mass may be due to polycystic kidney or hydronephrosis. The latter may be corrected by relief of obstruction and risk of future infection removed. Nephrectomy will result in restoration of normal visceral relations. The diagnosis of polycystic kidney is of prognostic value only. A solid mass may be a neuroblastoma or a Wilms' tumor. Skeletal and chest roentgen studies are of prognostic value in relation to metastases. Pyelograms are especially useful and may offer the only preoperative proof of normal function of the opposite kidney.

- C. *Difficult Swallowing:* Excessive drooling or spitting up of the first feeding is usually caused by esophageal atresia, with or without tracheal communication. Since aspiration is so frequent, iodized oil, instead of barium, should be used to confirm the diagnosis.
- D. *Vomiting and abdominal distention* in the newborn are usually due to obstruction of the small bowel or upper colon. Roentgen studies of the abdomen may locate the site of occlusion. With imperforate anus, helpful preoperative information may be obtained by taking roentgenograms with the child inverted and an opaque marker in the anal dimple to determine the space between the blind rectal pouch and the skin.

The authors conclude that close cooperation between the roentgenologist and pediatrician is essential to optimum care of emergencies in the newborn.

Seven roentgenograms; 1 graph.

JOHN P. FOTOPOULOS, M.D.
University of Michigan Hospital

Tumors in One of Homologous Twins. Neuroblastoma; Fibromyxosarcoma in Infant Negro Twins. Herman Charache. *Am. J. Roentgenol.* 70: 810-813, November 1953.

The author presents 2 cases of tumor in one of homologous twins, making a total of 6 such cases seen at the Brooklyn Cancer Institute and reported by him.

The first of the present cases was that of a six-month-old Negro female infant with a proved neuroblastoma which originally manifested itself as a tumor on the right lower eyelid. She received a course of roentgen therapy and was followed over a two-year interval, during which time regional metastases developed. Death was due to pulmonary metastases. The other twin is normal and has been followed for eight years since the mother first noticed the tumor in the sister.

The second case, also in a Negro female, was a proved fibromyxosarcoma originating in the abdominal wall in the left lower quadrant. Surgical removal of the tumor was followed by roentgen therapy. The tumor recurred, was surgically excised, and postoperative roentgen therapy was given to the scar. The child has been followed for eight years—until the age of nine—without recurrence or metastasis. Her twin sister is in good physical condition and free of neoplasm.

Four photographs; 2 photomicrographs.

ROBERT H. LEAMING, M.D.
Memorial Center, New York

Hyperglobulinemic Purpura of Waldenstroem and Benier-Boeck-Schaumann Disease. A. Gautier and P. A. Maurice. *Schweiz. med. Wchnschr.* 83: 1110-1114, Nov. 14, 1953. (In French)

In 1943, Waldenstroem in a study of patients with hyperglobulinemia reported 3 cases with associated purpura. By 1952, 13 such cases had been recorded. These patients have two principal symptoms: purpura and protein disorder.

The purpura is of chronic nature, being characterized by remissions and exacerbations, each purpuric spot leaving generally a small bronzed scar. The lesions appear most often on the lower extremities, especially after long periods of standing or walking. Increased capillary fragility is usually present. The erythrocyte

sedimentation rate is increased to a level of 60 to 100 mm. per hour. The protein of the serum is elevated to 80 to 100 gm. per liter, the globulins, chiefly gamma globulin, attaining a level of 50 to 60 gm. per liter. The course of the disease may last many months or years, with benign evolution.

The authors report the case of a 50-year-old female seen in July 1952, with hypertension, numerous pulmonary calcifications, abdominal calcifications (mesenteric nodes), a positive Mantoux reaction, and hyperglobulinemia. In October 1952, she had an episode of left facial neuralgia, which yielded to therapy with vitamins B and C. In November 1952, purpuric spots were noticed on the left thigh. The purpuric elements slowly resolved, leaving small bronzed scars. Successive hemograms revealed anemia and eosinophilia. The sternal marrow was rich in eosinophils and plasmocytes, the latter containing cytoplasmic inclusions. The globulin fractions, especially the gamma portion, were increased.

In May 1953, extreme pain in the left leg failed to respond to vasodilators and arteriectomy, so that amputation at the lower third of the thigh was performed. Pathologic examination revealed arteries with thickened walls, moderate plasmocytic infiltration, atheromatous intimal plaques, and arterial thrombi. In the muscles, nodular epithelioid lesions without caseation or tubercle bacilli were found. Thus it was concluded that the patient had sarcoidosis, the probable underlying cause of the syndrome in this case.

Two roentgenograms; 3 photomicrographs; 1 table.

CHARLES M. NICE, M.D.
University of Minnesota

TECHNIC

Supervoltage Diagnostic Roentgenography. A Preliminary Report. William J. Tuddenham, John Hale, and Eugene P. Pendergrass. *Am. J. Roentgenol.* 70: 759-765, November 1953.

Theoretical considerations indicated that roentgenography using a supervoltage technic would prove of value in the demonstration of small soft-tissue lesions centrally located in the chest, which are obscured by overlying bony structures when conventional 60 to 80 kv. roentgenography is used. From preliminary observations it was concluded that further investigation and development of this technic were justified. For an account of these studies, see *Radiology* 63: 184, 1954.

Two roentgenograms; 1 table.

J. L. CLEMENTS, M.D.
Atlanta, Ga.

A New Method of Stereoscopic Roentgenography: "Twist Stereo" Method. Elias Gordon and Joseph Sauro. *Am. J. Roentgenol.* 70: 824-826, November 1953.

The authors have devised a new method of stereoscopic roentgenography called the "Twist Stereo" method which eliminates the need for shifting the tube. The stereoscopic effect is produced either by a slight rotation or inclination of the part being examined or of the entire body. The twist produces stereoscopic roentgenograms like those taken by conventional cross shift, while the use of a tilt gives the up-and-down shift effect. The best results are obtained if a rotation or inclination of 5 to 7 degrees is used.

In doing away with the tube shift, the use of a much smaller cone is possible and consequently the quality and sharpness of the roentgenogram are improved. The time of doing a stereoscopic examination is shortened, and the problem of direction of grids is no longer a factor.

The method can also be used in making stereoscopic spot roentgenograms in myelography. The roentgenogram resulting from this method can be viewed in the vertical position.

One photograph. ROBERT H. LEAMING, M.D.
Memorial Center, New York

RADIOTHERAPY

The Calculation of Dosage in Interstitial Radium Therapy. Edith H. Quimby and Victoria Castro. *Am. J. Roentgenol.* 70: 739-749, November 1953.

The authors emphasize that this paper contains no clinical data but deals only with a part of the first step in interstitial radium therapy—namely, planning the implant, once the dose has been decided upon. The investigation was carried out in order to test the applicability of the Manchester system for needles of different strength, and for the modified distributions necessitated by radium sources available in America, to find out what latitude in planning would be permissible, retaining the use of their tables.

The study of dosage distribution in volume implants was made for radium distributions approximating those of the Paterson and Parker system, but using only needles containing 1 mg. of radium per centimeter of active length. For single-plane and two-plane implants, three distributions were studied. In the first, the division of total radium between periphery and area was essentially the same as that of Paterson and Parker. Separation of needles over the area varied from 1.2 to 1.7 cm. instead of the 1.0 cm. or less recommended. In the second group, the spacing of the needles over the area was reduced to conform to Paterson and Parker's system but, since the needles were all full strength, this resulted in a considerably higher ratio of central to peripheral radium than their rules specify. In the third group, the spacing was the same as in the second, but all central needles were reduced to half strength. Under these conditions, for the smaller fields the peripheral radium average three times as much as the central; for the larger, 40 per cent more. For each of these arrangements, four areas were studied, 3×3 cm.; 2.7×5 cm.; 5×5 cm., and 6×8 cm.

In the single plane implant group, for each area and for all three arrangements, dose rates were calculated in a plane 0.5 cm. from the plane of the needles, for points forming a 0.5 cm. lattice over one quadrant. The average of these was taken, and variations of the maximum and minimum points from this average determined. The number of milligram hours required to deliver 1,000 r was calculated from the average value. In these schemes, the extreme variations in the plane of reference are: Group 1, from -12 to +22 per cent; Group 2, from -14 to +18 per cent; Group 3, from -12 to +18 per cent. It appears that none of these plans is quite as good as the true Paterson and Parker arrangement, as was to be expected. However, the variations are probably not large enough to cause any of the plans to be totally unacceptable. It must be remembered that closer to the needles than this plane of reference, much greater variations appear.

The authors have accepted the data of Strandqvist, Garcia, and Paterson, who have indicated that for a decrease in overall time from six to eight days to three or four days, a decrease in radium dosage should be of the

order of 18 per cent. This implies that 5,000 to 6,000 r in three or four days might be expected to produce the same effect as 6,000 to 8,000 r in six to eight days. The average dose rates for the area studied and the times for 5,000 and 6,000 r are presented in a table. Plan 1 gives the dose in about the right time; Plan 2 has rather high dose rates, whereas Plan 3 dose rates are low. Plan 2 would probably be preferred to Plan 1 on a basis of homogeneity of radiation dosage, but the dose rate is somewhat too high for the dose level suggested above. Plan 3 furnishes both good homogeneity and a satisfactory dose rate; it requires, however, a supply of half-strength needles.

Similar calculations have been made utilizing two-plane implants. Studies were also made with volume implants of varying sizes, with particular reference to the factor of uncrossed ends. The dose rates in these cylindrical implants using only needles of 1 mg. per cm. active length are all high. It appears, therefore, that if only needles of 1 mg. per cm. active length are available, either wider separation or shorter irradiation time will have to be resorted to. For wider separations, the homogeneity becomes definitely less. The dose level of 5,000 to 6,000 r in three or four days, as stated above, was based on the publications of Strandqvist, Paterson and others. If the straight line relationship of the various authors is accepted, the two-day dose which should be equivalent to those discussed above is about 4,500 r. All arrangements using needles of 1 mg. per centimeter active length have too high a dose rate even for this.

The conclusion is inescapable that a supply of weak needles is highly desirable, unless a whole new series of treatment plans is to be evolved, based on very short irradiation times. This would need considerable clinical research.

[This excellent article should be studied thoroughly and understood fully by all students of radium therapy. —R.A.E.]

Nine diagrams; 3 tables.

RICHARD A. ELMER, M.D.
Atlanta, Ga.

Remote Fluoroscopic Control of Radiation Therapy by Screen Intensification. Preliminary Report. Russell H. Morgan, Ralph E. Sturm, Lowell S. Miller, and Daniel J. Torrance. *Am. J. Roentgenol.* 70: 705-708, November 1953.

The great effort expended in recent years on the development of instruments whereby the brightness of the fluoroscopic image may be increased by many times has been motivated primarily by the need for improved fluoroscopic acuity in roentgen diagnosis. It is pointed out by the authors that these devices will be of great value in roentgen therapy as well. With fluoroscopic control continuous through radiation

therapy, it is obvious that one will be able to maintain the relationship of radiation to the lesion while at the same time keeping the size of the irradiation field to a minimum. Remote control of such an apparatus is necessary for continued use in order to prevent an undesirable amount of irradiation to the therapist.

The authors describe an intensifier which they have used. It is composed of two portions: (1) a radiation detector and (2) a viewing unit. The radiation detector includes a fluoroscopic screen of conventional type, a high-speed optical system, and an electronic tube of the image-orthicon type. The fluoroscopic images appearing on the fluorescent screen are focused by the optical system on the photosensitive surface of the image-orthicon, which converts them into an electric current. This current is carried to the viewing unit, where it is amplified and impressed upon a kinescope (or television picture tube). The kinescope reconverts the electrical signal into a visible image, which is similar in pattern to the original fluoroscopic image but many times brighter because of the amplification process in the instrument. Furthermore, since the instrument overcomes some of the deficiencies of the eye when operating at the low levels of brightness of conventional fluoroscopy, the bright fluoroscopic image on the kinescope may be made to possess greater clarity than that of conventional unintensified fluoroscopic images.

There will be many advantages when such an instrument can be adapted to therapy equipment as it exists today. In the first place, the alignment of the roentgen beam with the lesion under treatment will be certain. Also, when each treatment is monitored continuously, movement of the patient during treatment can be recognized immediately and corrected. The relationship between movement and tumor irradiation is particularly important in rotational therapy. Many secondary advantages will also accrue.

Two illustrations. RICHARD A. ELMER, M.D.
Atlanta, Ga.

Volume Dosage Distribution in the Female Pelvis in Radium Therapy. Morton M. Kligerman and Jeanne D. Richmond. *Am. J. Roentgenol.* 70: 750-755, November 1953.

The authors have constructed isodose curves for multiple frontal planes through the pelvis, anterior and posterior to a reference plane which is a frontal plane through the superior end of the most inferior radium capsule. This tube of radium is always in the lower cervical canal. For further orientation, the inferior end of the lowermost intrauterine capsule is placed at the external os.

Initially the isodose curves were worked out using an idealized Corscaden type implant. All the needles in this implant had a radium content of approximately 1 mg. per centimeter. The three tubes in the uterine canal contained 10 mg. each. The filtration of the needles is 0.5 mm. platinum; that of the tubes is 1 mm. platinum. When the radium sources in the uterine canal and in the stockade of needles around the periphery of the cervix were reduced to half the strength used in the typical Corscaden implant, the dose at a parametrial point was increased from 38.6 per cent of the cervical dose to 61.1 per cent. At the same time there was a slight increase in paracervical dose.

The isodose lines charted at various planes represent

the doses in r/hr. with 15 mg. of radium in the tandem, 1 mg. of radium in each of the 8 needles in the stockade around the cervix, 2 mg. of radium in each of the needles in the paracervical areas, and 5 mg. of radium in each of the long parametrial needles.

By applying these curves on the anteroposterior roentgenogram of the patient with the needles in place, the approximate dose at any point in the pelvis can be readily estimated.

Eight illustrations. RICHARD A. ELMER, M.D.
Atlanta, Ga.

Influence of X-Ray Cones on the Dose. Stephan Epstein, J. M. Wickham, and Wolfgang Epstein. *Arch. Dermat. & Syph.* 68: 549-552, November 1953.

A study was made of the influence of cones on the dose in superficial x-ray therapy. Measurements were carried out on three Picker-Waite Zephyr units. Commercial cones of different field sizes were investigated—2.0, 2.5, 2.8, 7.5, 10, and 15 cm., respectively. Physical factors were 80 kv., 4 and 5 ma.; no filter. The focus-skin distance was usually 20 cm., but for certain measurements it was increased up to 55 cm. By means of a fluoroscopic screen, it was made certain that the x-ray field fully covered the chamber of the measuring Victoreen instrument.

The following conclusions were reached: The use of cone on superficial x-ray machines influences the actual dose. The dose given through a cone may be identical with, or smaller or larger than that without a cone. In 2 cases the use of a small cone reduced the dose by about 12 per cent. This is a considerable discrepancy which cannot be ignored in the treatment of a malignant lesion of the skin or lip. No influence upon the dose was noted when a cone of 15 cm. was used.

The implications of these findings are discussed. It is suggested that the manufacturers consider this influence of the cone and so construct cones as to eliminate these variations. It is also suggested that users of such equipment have their machines measured with and without cones to determine the actual dose delivered to the patient.

One illustration; 1 table.

Use of Duplast in Radiation Therapy. J. W. Calvert. *Arch. Dermat. & Syph.* 68: 582, November 1953.

The author has found Duplast, a double-coated Elastoplast which is made of rubber, resins, zinc oxide, and wool fat, useful for holding lead shields in place when close shielding is desired in radiotherapy. He has used it with both radium plaques and radium molds. If filtration is employed, one layer of Duplast is placed between the skin and the filter and another between the filter and the plaque or mold. If no filtration is employed, one layer only of Duplast is used, between the plaque or mold and the skin.

The filtration furnished by Duplast is of such a minor nature that it can be ignored except where the added distance is important (as with the radium plaque).

Tumor of the Glomus Jugulare. Follow-up Study Two Years After Roentgen Therapy. Eben Alexander, Jr., and Stewart Adams. *J. Neurosurg.* 10: 672-674, November 1953.

The authors report the results of roentgen therapy of an inoperable glomus jugulare tumor involving the left petrous pyramid and presenting through the left

ear drum. The patient received 2,080 r (in air) through each of two 10 × 10-cm. occipital portals over a period of nineteen days. Six weeks later, at another institution, 9,000 r were given over a right occipital portal. Two years after treatment there was marked subjective and objective improvement.

The authors suggest that the unusual vascularity of the tumor in this case, as shown by angiography, might account for its radiosensitivity. There was nothing in the microscopic picture that might have led to a prediction of radiosensitivity.

Two roentgenograms. JOHN J. CRAVEN, M.D.
Cleveland Clinic

Radiation Therapy in Carcinoma of the Thoracic Esophagus. Denis C. Adler and Paul H. Deeb. *Am. J. Roentgenol.* 70: 709-720, November 1953.

The authors report their results in 3 cases of carcinoma of the esophagus treated at the White Memorial Hospital, Los Angeles, Calif. They were prompted to present these cases because many local radiologists had indicated that they would prefer to discard radiation therapy entirely in this disease.

Two patients came to autopsy seventeen and thirty-four months, respectively, following combined external and intracavitary radiation therapy. In neither was there any evidence of residual tumor. One of these patients, a woman of seventy-three, reacted poorly to the irradiation, with progressive stenosis of the esophagus, requiring the use of a Levin tube during most of the post-irradiation course. The response in the other case was more favorable, with only occasional attacks of dysphagia over a two-year period. In the third reported case, with survival after twenty-five months, there was no evidence of recurrence clinically, roentgenologically, or by esophagoscopy and biopsy. This patient died of heart disease, and autopsy was not permitted.

The authors have aimed at and have usually achieved a tumor dose of between 4,500 and 6,000 r, this being delivered with conventional 200-kv. therapy, with 2 mm. copper filtration, through six or more long narrow portals. They have also given additional therapy by tandem radium in the esophagus, using up to six 25-mg. sources end to end. An exact radium dose is not recommended but it is suggested that perhaps one-third of the radiation to the esophagus be delivered by way of radium.

The authors have pointed out again that adequate irradiation in carcinoma of the esophagus can be given without the benefit of supervoltage therapy or rotation therapy and have emphasized that the negative attitude toward this form of treatment is not justified.

Six roentgenograms; 3 photomicrographs; 1 photograph. RICHARD A. ELMER, M.D.

Atlanta, Ga.

Wilms' Tumor in Children. Robert A. Garrett and H. O. Mertz. *J. Urol.* 70: 694-703, November 1953.

Among 78,961 admissions to the James Whitcomb Riley Hospital for Children (Indianapolis) in a twenty-five-year period, 23 cases of Wilms' tumor were seen, including 4 in which nephrectomy had previously been performed elsewhere. In all of these patients a palpable loin mass was present on admission. Such a mass in a child should arouse suspicion. Excretory

urology is often diagnostic, showing distortion of the calyceal pattern, with medial, anterior, or inferior displacement. Superior displacement is infrequent and lateral displacement even more so. To be differentiated are other abdominal masses, as hydronephrosis, neuroblastoma, adrenal neoplasms, and renal cysts.

Treatment is controversial. Several cures have been reported with radiotherapy alone (eight references to such cases are included), though nephrectomy is usually considered essential. The controversy concerns the combination of radiation and surgery. The authors advocate individualization, using preoperative irradiation when the tumor is formidably large and discontinuing this not after a previously calculated dose but as soon as regression in size is sufficient to permit skillful execution of nephrectomy. They employ postoperative irradiation routinely.

Of the 19 patients in this series treated primarily, 9 underwent nephrectomy, 4 transabdominally and 5 by the lumbar route. Eight of these were living and well at the time of the report, after periods ranging from eighteen months to over eleven years.

Seven patients were denied surgery because they were considered inoperable and 3 others were found to be inoperable on exploration. Eight received x-ray therapy alone. In 3 the dosage was not recorded. In the other 5 the amount ranged from 1,800 to 14,600 r. Technical factors were: 200 kv., 50 cm. distance, 0.5 mm. copper and 1.0 mm. aluminum filtration, h.v.l. 0.9 mm. copper. Three ports were used in rotation, with a daily dose of between 100 and 200 r for a planned total of 2,000 r to each field, giving a dose of 3,000 to 3,500 r to the center of the tumor. All of these patients died.

In the patients who lived, surgery and x-ray therapy were combined. Whether the cure should be attributed to the combination, to surgery, or to irradiation is not answered. In contrast to the amount of radiation received by those to whom surgery was denied, those now living and well received varying doses from 4,200 r preoperatively to 21,600 r preoperatively plus 2,000 r postoperatively. One in this group received 8,200 r preoperatively; another received 5,400 r preoperatively plus 3,000 r postoperatively. It is not clear whether all the doses enumerated are tumor or air doses.

Seven roentgenograms; 3 tables

DONALD DEF. BAUER, M.D.
Coos Bay, Ore.

Sympathicoblastoma of the Adrenal Medulla with Osseous Metastases. Report of Three Cases Including One Surviving Eleven Years after Roentgen Therapy. Poul Bjerre Hansen. *Acta radiol.* 40: 500-510, November 1953.

Three cases of metastasizing sympathicoblastoma arising from the adrenal medulla are reported. One of these is felt to be exceptional because the child was alive eleven years after roentgen therapy despite the presence of widespread osseous metastases. This case was originally reported by Rosendal (*Acta radiol.* 23: 462, 1942. *Abst. in Radiology* 45: 94, 1945). The other 2 patients died. One of these had metastases both to the liver and bone, a mixed form of the Hutchinson and Pepper types of the disease. During recent years several similar cases have been reported and it now seems generally agreed that there is little difference between the two types. However, it may be practical to

retain the two designations for the purpose of clinical description.

The osseous metastases of sympathicoblastoma share a predilection for the skull, especially the orbital region, with the chloromas and granulomas of Hand-Schüller-Christian disease. Urography and pneumoradiography of the retroperitoneal space are important diagnostic methods, but are not discussed in this paper, which is concerned chiefly with prognosis and therapy.

Up to the early 1940's, it was generally agreed that the prognosis of sympathicoblastoma was extremely grave, the disease running a rapid and fatal course in a few months. Rosendal found only 2 cures among 300 cases published up to 1940. One patient was alive and well more than fifteen years after removal of the tumor, and the other was free of recurrence more than two years after roentgen treatment. Cushing and Wolbach (Am. J. Path. 3: 203, 1927) reported a case in which spontaneous recovery seems to have occurred due to differentiation of the malignant cells in a normal direction, resulting in transformation into a benign ganglioneuroma. Wittenborg (Radiology 54: 679,

1950) obtained 66 per cent three-year cures in a group of 9 cases treated by combined surgery and irradiation. In 21 of his series, with metastases, irradiation was the only treatment. Of 6 patients whose metastases were limited to the liver, all were alive and well after three to twelve years; cases with bone metastases invariably terminated fatally within a year.

Attempts have been made to treat sympathicoblastoma with radioactive substances and nitrogen mustard, but results have not been very promising. For the present it must be assumed that in the presence of a local primary tumor, surgical methods represent the most rational form of therapy. All other cases should be treated with roentgen irradiation, even when extensive metastases have developed. The palliative effect is valuable, and the course of the disease in the first of the cases reported here seems to indicate that growth both of the primary tumor and bone metastases may be arrested.

Four roentgenograms; 1 photograph.

A. J. NICHOLAS, M.D.
Shreveport, La.

RADIOISOTOPES

Recent Advances in Radioisotope Therapy. Charles F. Behrens. South. M. J. 46: 1155-1163, December 1953.

This article is a review of the recent applications of radioisotopes to medical and biological problems. The author discusses the use of I^{131} , P^{32} , Co^{60} , Ga^{72} , Cs^{137} , Sr^{90} , Au^{198} , and other radioactive isotopes.

One table. HOWARD L. STEINBACH, M.D.
University of California

The Uptake of Radioactive Iodine by Carcinoma of the Thyroid Gland: A Study of 128 Cases. B. Marden Black, Lewis B. Woolner, and Charles M. Blackburn. J. Clin. Endocrinol. & Metab. 13: 1378-1390, November 1953.

The less anaplastic carcinomas of the thyroid with follicular arrangement of cells, particularly if they contain colloid, are more likely to concentrate radioiodine than are other thyroid carcinomas. There are many exceptions, however, and ability to take up iodine can be determined only after ablation of the thyroid and prolonged treatment with thiouracil, an undertaking of considerable magnitude and some risk. The authors attempted to determine if patients with inoperable carcinoma could be selected for radioiodine therapy on the basis of type and histologic features of the lesion.

The classification of thyroid carcinoma used at the Mayo Clinic, from which the report comes, recognizes three main groups: (1) papillary adenocarcinoma, (2) malignant adenoma, and (3) anaplastic carcinoma. Representative tissue of 115 cases was studied by autoradiographs following the use of radioiodine, either diagnostically or therapeutically. Other cases were studied in which uptake of iodine had been stimulated by thiouracil or thyrotropic hormone after ablation of thyroid gland.

Of 70 cases of papillary adenocarcinoma, 24 were predominantly papillary, 32 mixed, and 14 predominantly follicular. Uptake of iodine occurred only in the predominantly follicular and mixed carcinoma in which follicles were well formed and colloid was present.

Four of the mixed carcinomas and 4 of the follicular-tumors became smaller with therapeutic doses of radioiodine.

Of 25 malignant adenomas, 10 were solid, 6 mixed follicular and solid, 3 predominantly follicular, and 6 of the Hürthle-cell type. In none of the solid type was there any initial uptake of iodine. In 3 the gland was ablated, but there was no stimulation of iodine uptake. Four of the 6 tumors of mixed type had good initial uptake, and in 2 cases treatment was successful. Of the follicular variety, 2 were treated successfully with radioiodine and 1 by surgery. The 6 Hürthle-cell tumors and 33 anaplastic tumors showed no initial iodine uptake and no response to stimulation.

After some discussion, the authors conclude that, with respect to the concentration of iodine, carcinomas of the thyroid can be assigned to one of three categories on the basis of histologic appearance. One group practically always concentrates, or can be stimulated to concentrate, iodine. This includes the follicular type of papillary adenocarcinoma and follicular, mixed follicular, and solid malignant adenomas. A second group may not initially concentrate iodine but will frequently do so after stimulation. Only the mixed follicular and papillary type adenocarcinoma is in this category. The third group almost never concentrates iodine initially or after stimulation. Papillary adenocarcinomas, solid and Hürthle-cell malignant adenomas, and anaplastic carcinomas constitute this group.

Nineteen photomicrographs.

GEORGE A. SHIPMAN, M.D.
New Orleans, La.

The Thyroidal Uptake of Stable Iodine Compared with the Serum Concentration of Protein-Bound Iodine in Normal Subjects and in Patients with Thyroid Disease. Belton A. Burrows and Joseph F. Ross. J. Clin. Endocrinol. & Metab. 13: 1358-1368, November 1953.

Uptake of radioiodine (I^{131}) by the thyroid is usually in good agreement with the state of thyroid function. This relationship is altered in patients receiving treat-

ment for thyroid disease or with gross alterations in intake of stable iodine (¹²⁷). Of particular clinical interest are (1) patients previously treated for hyperthyroidism by radioiodine or surgery who continue to have high radioiodine uptake while remaining euthyroid by laboratory tests, and (2) treated patients having a normal uptake although still hyperthyroid. Two possible explanations are suggested by these findings: (1) a glandular disorder such that iodine is not released as hormone; (2) changes in the amount of stable iodine in extracellular fluid available for thyroid uptake, resulting in alteration of the uptake of radioactive iodine that would ordinarily occur at a given level of thyroid function.

The authors' observation of two groups of patients support the latter view. One group consisted of normal individuals and untreated patients with thyroid disease. The other group was composed of patients who had been treated for hyperthyroidism by some standard method. Determinations of stable iodine uptake by the thyroid, and of the amount of thyroid hormone utilized peripherally at various serum concentrations, were made. Radioiodine uptake by the thyroid showed significant correlation with serum protein-bound iodine concentration in normal subjects and in patients with untreated thyroid disease. Patients who had been treated for hyperthyroidism showed greater variation than did the untreated. The stable iodine uptake in a small group of patients with high radioiodine uptake showed a good correlation with the serum protein-bound iodine concentrations. The stable iodine uptake apparently bears a direct relationship to the serum-bound iodine concentration, so that increases of 3.5 micrograms per 100 c.c. in the serum protein-bound iodine concentration indicate a threefold increase in thyroid hormone output and utilization.

Four charts; 2 tables.

GEORGE A. SHIPMAN, M.D.
New Orleans, La.

A Radioiodine Tracer Study of the Fate of Human Thyroid Autotransplants. D. Emerick Szilagyi, John L. Barrett, Edward R. Longabaugh, and Luther E. Preuss. *J. Clin. Endocrinol. & Metab.* **13**: 1347-1357, November 1953.

Regenerative growth capacity of the thyroid gland has long been assumed on grounds of animal comparison studies and clinical observation following thyroidectomy. Radioisotope tracers make evaluation studies possible and grossly indiscernible fragments inadvertently left *in situ* have sometimes been shown to be capable of detectable function.

The authors studied the problem of parenchymal regeneration of thyroid tissue by the use of autotransplants, utilizing radioisotope methods. There were three cases each of diffuse hyperplastic goiter, toxic adenomatous goiter, and non-toxic adenomatous goiter. Either the entire gland or all but a small part of one lobe was removed. In each case a graft was imbedded in the sternocleidomastoid muscle on the side containing no thyroid tissue. Thyroid therapy was given following operation. Function studies were begun as early as feasible and repeated every ninety days by the usual ¹³¹I tracer method. In every instance activity of the gland was detected but it developed most rapidly and to a greater degree in those having diffuse hyperplastic goiter.

The authors state that a systemic demand for thyroxine is a necessary condition of growth of the graft, but other factors seem more important. They suggest that grafts may grow better in young patients. All but one patient became euthyroid, requiring no thyroid supplement. In one patient, hypothyroidism is slowly progressing, possibly due to too small a transplant. The transplants may resume accumulating iodine as early as ten days postoperatively.

Their studies lead the authors to conclude that (1) function increases progressively, probably due to the growth of the graft; (2) rate and magnitude depend largely on the tissue type of the transplant, hyperplastic goiter being best; (3) systemic demand for thyroxine and age of the donor may be factors influencing survival and growth of transplant.

Six illustrations; 5 tables.

GEORGE A. SHIPMAN, M.D.
New Orleans, La.

The Blood Level as a Guide to Therapy with Radioiodine. J. E. Rall, Martin S. Sosenberg, Jacob Robbins, R. Lazerson, and Rulon W. Rawson. *J. Clin. Endocrinol. & Metab.* **13**: 1369-1377, November 1953.

The increasing use of radioiodine for treatment of hyperthyroidism in younger patients makes it desirable to produce a remission with the minimal amount of radiation. Because of variation in size of the thyroid and utilization of iodine, each case must be treated individually. The proper dose can be calculated from preliminary tracer studies to determine utilization time but this requires prolonged observation. Furthermore, tracer doses and therapeutic doses disappear from the thyroid at different rates because the therapeutic dose alters the physiology of the gland. The radioiodine lost from the thyroid becomes labeled hormone in the blood stream.

The authors studied 116 hyperthyroid patients to test their theory that a single determination of labeled thyroid hormone in the blood could be used to estimate turnover rate of iodine by the thyroid. At forty-eight hours the uptake of the tracer dose was measured, the amount of radioiodine in the blood was determined, the thyroid weight estimated, and the therapeutic dose calculated. A positive correlation was found between the level of radioiodine in the blood and the incidence of inadequate dosage. Results were sufficiently consistent that a formula for dosage could be derived. The following is the complete equation: $D = [100(110 + 27B) \times G]/U$, where D is the dose in microcuries, G is the weight of the gland, and U is the percentage uptake of the tracer dose in forty-eight hours. The expression $(110 + 27B)$ indicates the microcuries to be deposited per gram of thyroid tissue at forty-eight hours, B representing the concentration of ¹³¹I in whole blood forty-eight hours after the dose.

Errors in calculation may occur if the thyroid gland weight is inaccurate, as for example if there is substernal extension of the thyroid. Such individuals were excluded from this study. Uneven distribution of the radioiodine in the gland may upset calculations, but there is no way to determine this factor and it was ignored by the authors. Patients with renal disease show diminished excretion of iodine from blood and were therefore excluded from this study. Variations in sensitivity of the gland to the radioiodine are theoretically possible, but the authors did not find this to be a

significant factor. Nevertheless, they did exclude nodular goiter from their study.

Four charts; 8 tables. GEORGE A. SHIPMAN, M.D.
New Orleans, La.

Treatment of Thyroid Cancer Metastases with TSH and I^{131} During Thyroid Hormone Medication. Charles T. Sturgeon, Fremont E. Davis, Boris Catz, Donald Petit, and Paul Starr. *J. Clin. Endocrinol. & Metab.* 13: 1391-1407, November 1953.

The authors present a review of 50 cases of thyroid carcinoma observed during the previous five years in 13 of which a euthyroid state had been maintained with desiccated thyroid or sodium-*L*-thyroxine. Increased retention of radioiodine was induced by TSH (thyroid-stimulating hormone) in 4 of the 13 patients. Exogenous thyroid hormone depresses endogenous thyroid secretion. The usual management in thyroid cancer is to produce profound hypothyroidism, which in turn causes increased TSH production by the pituitary. The TSH causes a chronic stimulation of the tumor and metastases, resulting in an increased uptake of the isotope. If such an increased uptake could be induced by parenteral TSH during pituitary suppression accomplished by thyroid hormone medication, the same advantage would be gained with desired reduction in growth of tumor.

The authors attempt to demonstrate that, with suppression of endogenous TSH, there will be a tendency to retard growth of tumor and occurrence of metastases. They divided their 50 cases into 27 papillary, 12 alveolar and follicular, and 11 "others," on the basis of the predominant histologic pattern. Most of the patients were young females. In 6 the first sign of cancer was a metastatic lesion. The interval between recognition of goiter or a mass and surgery with pathologic diagnosis ranged from seven months to forty-one years. The range of survival time following surgery was from seven months to twenty-five years, several patients being still alive. The metastases in 33 patients followed the usual pattern, spreading to regional nodes and lungs in the papillary type, to bones and lungs in the follicular, and to unpredictable areas in others.

Since most metastatic lesions are non-functioning, some method to stimulate their activity is necessary if they are to be destroyed. Induction of the hypothyroid state by ablation of the thyroid gland, suppression of iodide uptake by thiouracil, and stimulation by thyrotropic hormone are the usual methods. In the author's series 14 patients were hypothyroid after removal of the thyroid gland, but in none of these was there an increase in uptake of radioiodine, and 6 of the patients are dead. These discouraging results led to an attempt to stimulate the metastatic lesions with thyrotropic hormone. All accessible thyroid gland and metastases were removed and the isotope was used to destroy remaining inaccessible thyroid tissue. Desiccated thyroid or *L*-thyroxine was given to maintain constant euthyroidism. Tracer studies with radioactive iodine were done to locate any collection of the isotope. TSH was then given for five or six days and the tracer studies were repeated to determine improvement in the uptake. If retention was greater, a therapeutic dose of radioiodine was given. If there was no change in uptake or retention of isotope, thyroid medication was continued for six months and the tracer studies were again repeated. Thirteen patients were subjected to this re-

gime. Two are dead, 3 improved sufficiently to be given therapeutic dose of radioiodine, and 10 were unimproved. Four illustrative cases are presented.

It is concluded that by suppression of endogenous TSH, the growth of cancer and occurrence of metastases may be retarded.

Thirteen illustrations, including 6 roentgenograms; 8 tables.

GEORGE A. SHIPMAN, M.D.
New Orleans, La.

Removal from Skin of Plasma Protein Labeled with Radioactive Iodine. R. P. Jepson, F. A. Simeone, and B. M. Dobyns. *Am. J. Physiol.* 175: 443-448, December 1953.

Solutions of radioactive sodium iodide (I^{131}) and of plasma protein labeled with I^{131} were injected into the skin of anesthetized dogs. The clearance rates from the deposit in the skin and the radioactivity in serial blood and lymph specimens were determined both in normal legs and in legs in which lymphatic or vascular obstruction had been created. The clearance rate of radioactive plasma protein was found to be much slower than the clearance rate of sodium iodide. Both tracer materials were detectable in blood and lymph samples and it is suggested that removal from the tissue spaces via the capillary bed is the major mechanism for both the crystalloid and protein molecule.

Seven charts.

Low-Cost I^{131} Thyroid Uptake Apparatus. Edward Siegel. *Nucleonics* 11: 64, October 1953.

An easily constructed, inexpensive unit for thyroid uptake studies, which utilizes an over-bed hospital table to support a shielded bismuth-wall gamma counter, is described. The total cost of the unit was \$275, of which \$150 was for construction of the shield housing, \$50 for the over-bed table, and \$75 for the G-M tube.

One photograph; 1 drawing.

A Time Study of the Incorporation of Radiophosphorus into the Nucleic Acids and Other Compounds of a Transplanted Mouse Mammary Carcinoma. Cyrus P. Barnum, Robert A. Huseby, and Halvor Vermund. *Cancer Res.* 13: 880-889, December 1953.

Mice bearing a transplanted mammary carcinoma were sacrificed at intervals ranging from fifteen minutes to sixteen hours after intraperitoneal injection of P^{32} , and the tumors were fractionated by differential centrifugation to yield nuclei, microsomes, an ultracentrifugable particulate fraction, and a supernatant fluid. From each of these fractions the nucleic acids, phospholipids, and protein residues were isolated, and the specific activities of the P of these constituents were measured along with the specific activity of the inorganic P derived from the whole homogenate.

The authors' observations are presented in numerous tables and charts and are discussed at length. Those interested in studies of this type should consult the original paper.

Distribution of Colloidal Radioactive Chromic Phosphate After Intracavitary Administration in the Rat. John A. D. Cooper and Elinor M. Zorn. *J. Lab. & Clin. Med.* 42: 867-871, December 1953.

The authors report an investigation of the distribution of chromic phosphate colloids of varying size following intracavitary administration in the rat.

Preparations of radioactive chromic phosphate with predominant particle sizes of 0.2 micron and 2 to 4 micra were employed in the investigation. The rats were white females of the Sprague Dawley strain, weighing from 177 to 270 grams. The radioactive colloid was diluted to a concentration of approximately 6 microcuries per milliliter with 0.85 per cent saline, and 5 ml. were injected intraperitoneally. For the intrapleural experiments 1 ml. of the colloid containing 30 microcuries of P^{32} was injected into the left pleural space after preliminary injection of 1 ml. of air. Urine was collected for two weeks. The animals were then sacrificed and samples of tissue were obtained for assay of the P^{32} content. Urinary excretion of P^{32} was negligible in all animals studied.

The 0.2 micron particles were much more readily removed from the pleural and peritoneal cavities than the larger particles. The addition of a stabilizing agent to the colloidal sol enhanced its removal rate. In general, the various organs studied contained a higher percentage of the radioactive colloid after intraperitoneal than after intrapleural administration.

Colloid with particle sizes of 0.2 micron was found in large amounts in the liver after both intrapleural and intraperitoneal administration. With larger particle size a smaller fraction appeared in the liver. Because of this finding the authors believe that caution should be exercised in the use of colloidal radioactive chromic phosphate in human beings. Although the danger of irradiation to the liver and spleen is apparently less with larger particles, their size and tendency to form aggregates may result in uneven irradiation within the cavity.

Effect of Whole Body X-Irradiation on the Reticulo-Endothelial System as Demonstrated by the Use of Radioactive Chromium Phosphate. Elemer R. Gabrieli and Aina A. Auskaps. *Yale J. Biol. & Med.* 26: 159-169, November 1953.

The authors have studied reticuloendothelial system activity in laboratory animals by means of intravenous injection of radioactive colloidal chromium phosphate ($CrP^{32}O_4$). This technic is used: (1) to show the disappearance rate of radioactivity from the blood, providing an overall picture of the activity of the reticuloendothelial system; (2) to show the distribution of radioactivity in different organs (distribution patterns of $CrP^{32}O_4$ in the organs of normal animals are fairly constant, and any change in distribution may be interpreted as indicating an alteration in function); (3) to permit radioautography of different tissues. In organs such as the liver and spleen a characteristic distribution pattern will be shown by this last method. Alteration of the activity of the reticuloendothelial system produces changes in the radioautograph.

In rats exposed to 25, 50, and 100 r of whole-body roentgen irradiation, no change in the removal rate of $CrP^{32}O_4$ occurred in the four-week period after irradiation.

Induced blockage of the reticuloendothelial system by Thorotrast was more effective in rats which had been subjected to 100 r irradiation than in controls, as judged by the disappearance rate of radioactive chromium phosphate from the blood stream. This suggests that reticuloendothelial capacity was diminished by the irradiation.

Organ distribution of $CrP^{32}O_4$ was altered after whole-body irradiation with as little as 25 r. The liver

showed increased uptake with a maximum around the seventh day. The spleen took up markedly less than the spleen of controls during the first three days, and in rats receiving 100 r the uptake was at a reduced level after fourteen days. The altered organ distribution was interpreted as a sign of impairment of selectivity after total-body irradiation.

Two graphs; 1 table. DONALD DE F. BAUER, M.D.
Coos Bay, Ore.

Uptake of Subcutaneous and Intramuscular Silver-Coated Radioactive Gold Colloids by Lymph Nodes in Dogs. Andrew H. Jackson, Frank E. Staggers, and P. F. Hahn. *J. Lab. & Clin. Med.* 42: 739-745, November 1953.

The authors investigated the efficiency of uptake of subcutaneous and intramuscular silver-coated radioactive gold colloids by regional lymph nodes in dogs. There appears to be a steady increase in nodal activity through the forty-eight-hour period studied. The use of hyaluronidase in conjunction with the colloid resulted in higher levels of activity in the nodes for a comparable time period. The data suggest that sufficient colloid is deposited in regional lymphatics in twelve to forty-eight hours to achieve destructive levels when larger quantities are employed. Though some of the infiltrated activity can later be recovered from the liver, the amount of radiation derived from such a route of administration would appear to be well tolerated by hepatic tissue.

Possibly some use could be found for these colloids, injected subcutaneously or intramuscularly, where it is desirable to destroy inaccessible nodes or prevent the organization therein of autonomous cells.

Five photomicrographs; 3 tables.

THEODORE E. KEATS, M.D.
University of California

A New Method, Using Radioiron, for Determining the Iron-Binding Capacity of Human Serum. A. R. Feinstein, W. F. Bethard, and J. D. McCarthy. *J. Lab. & Clin. Med.* 42: 907-914, December 1953.

A new method for determining the iron-binding capacity of human serum is described and the theoretical and experimental aspects of its validity are discussed. The method consists in adding to serum a quantity of radioiron of known specific activity in an amount greater than that required to saturate the protein, allowing the radioiron to combine with the protein, separating the iron-saturated protein from the solution with the use of ammonium sulfate, measuring the excess of unbound radioiron, and thereby calculating the quantity of iron bound.

The method has quantitative and qualitative advantages over the existing spectrophotometric technic, chiefly in the wider range of the types of sera to which it is applicable and the greater accuracy of measurement which it provides.

Using the radioiron technic, it is theoretically possible to calculate the original amount of protein-bound serum iron, as well as serum iron-binding capacity. Further experiments are in progress along this line.

Radiation Decomposition of Carbon-14-Labeled Compounds. Richard M. Lemmon. *Nucleonics* 10: 44-45, October 1953.

Recent observations at several laboratories have

shown that organic compounds labeled with carbon-14 are capable of extensive decomposition under the influence of their own radiation. Data presented in this article suggest that occasionally decomposition may proceed through some type of chain reaction, and that destruction of the labeled compound may thus be far more severe than expected. In view of the volume of research carried on with carbon-14 labeled compounds, it is important that researchers recognize this hazard to correct interpretation of their experimental results.

Methods for determining radiopurity and preventing decomposition are considered.

One table.

Boron Detection in Tissues Using the (η , α) Reaction. Giovanna Mayr, H. D. Bruner, and Marshall Brucer. *Nucleonics* 11: 21-25, October 1953.

In relation to the larger problem of using neutrons for medical purposes, such as to irradiate neoplasms, experiments were carried out to determine whether boron could be detected in tissues at very low concentrations using the $B^{10}(\eta, \alpha) Li^7$ reaction. Autoradiographic results obtained with this reaction indicate that a method can be developed for determining boron distribution at low concentrations. Improved statistics should be attainable with more intense neutron fluxes.

RADIATION EFFECTS; PROTECTION; EXPERIMENTAL STUDIES

Osseous Damage in Irradiation of Renal Tumors in Infancy and Childhood. Walter M. Whitehouse and Isadore Lampe. *Am. J. Roentgenol.* 70: 721-729, November 1953.

Vertebral damage and unilateral underdevelopment of the ilium have been demonstrated in 4 patients surviving ten years or longer following irradiation in infancy and childhood for renal tumors. These cases are presented by the authors and discussed fully. Roentgenograms accompany each case report.

The factors of field size, daily dose, total dose, and duration of treatment are compared in the individual cases. The most intense damage was obtained in the patient with the high daily dose and overall short treatment time. The degree of bone damage is related to dosage factors. Adequate protraction, with small daily doses, smaller field size, and lower total dosage, leads to diminution of eventual bone damage.

A patient with a proved Wilms' tumor (inoperable), survived following an intensive course of irradiation, but with severe vertebral damage and scoliosis. A second patient with Wilms' tumor treated by irradiation for residual neoplasm following nephrectomy survived after less intensive irradiation, with minimal vertebral damage and no scoliosis. The dosage factors were apparently still within the limits of effective tumor treatment in the latter case.

The authors compare their data with the observations of Neuhauser and Wittenborg (*Radiology* 59: 637, 1952), who have suggested that radiation fields include the entire vertebral body in order to decrease the incidence of scoliosis. The present authors, however, state that this would usually require a larger rather than a smaller field size and still would not assure uniform irradiation to both sides of the vertebral epiphysis, situated as it is at the edge of the field of radiation.

Four radiographs; 1 table.

RICHARD A. ELMER, M.D.
Atlanta, Ga.

Spontaneous Fractures of the Femoral Neck After the Intensive Irradiation of Carcinoma of the Uterus. G. Kok. *Acta radiol.* 40: 511-527, November 1953.

Irradiation procedures for carcinoma of the uterus in which the femoral neck is transversed by part of the rays involve the risk of subsequent spontaneous fracture of the neck in a certain percentage of older patients.

Thirteen cases of spontaneous fracture of the femoral neck occurred in 896 cases of carcinoma of the cervix and uterus treated at the Rotterdam Institute of Radio-

therapy between the years 1941 and 1950. Bilateral fractures were seen in 5 cases and fracture of the true pelvis twice. The average age was sixty-three years. Eleven cases had been treated through an 18 X 18-cm. anterior field bisected by a lead strip 3 to 4 cm. wide, a posterior field of the same size, and right and left lateral fields, 15 X 15 cm., with the central beam directed toward the parametrium. These fields for the most part received a dose of 2,000 r measured in air, divided into two series of 1,200 and 800 r, respectively, with a six-week interval. [Kilovoltage and half-value layer are not stated.]

The initial opinion of many authors and also that held in the Institute was that the lateral fields were the chief cause of the heavy dose to the femoral head and neck. Measurements in a phantom of water and a female pelvis of average size show, however, that with the above technic the head and the medial part of the neck of the femur were liberally exposed to irradiation through the anterior and posterior fields.

The prognosis of a spontaneous fracture of the femoral neck after irradiation appears favorable. Since pain may be present for a considerable time before fracture occurs, the complication may be avoided by early diagnosis and conservative measures—immobilization and attention to the patient's general condition.

Improvement in technic may prevent the occurrence of fracture. Its treatment is briefly discussed. A Smith-Petersen-Johansson osteosynthesis is considered undesirable for the following reasons: (1) During the acute stage, the metal pin will doubtless do still more damage to the vascular supply in the vulnerable region of head and neck and increase the risk of necrosis. Moreover the pin would have to be inserted into a region in which the trabeculae are very much atrophied. (2) If there is considerable displacement of the fragments, the risk of necrosis becomes still greater as rupture of the last main distal nutrient vessels disturbs the blood supply to the head still more.

Five roentgenograms; 6 photomicrographs; 2 tables.

A. J. NICHOLAS, M.D.
Shreveport, La.

ACTH in Radiation Cystitis. Lester Persky and George Austen, Jr. *J. Urol.* 70: 724-728, November 1953.

ACTH was utilized in the treatment of 3 patients with bladder injuries secondary to radiation therapy. In 2 it was administered intravenously, and in 1 intramuscularly. The interval between irradiation and

the symptoms (dysuria, urgency, hematuria, etc.) varied from six months to ten years.

Intravenous dosage was 20 mg. daily for ten days, the drug being given in 1 liter of 5 per cent dextrose in water over a six- to eight-hour period. The intramuscular dose was 20 mg. every four hours for ten days. Relief of dysuria was rapid in onset but of unpredictable duration. Increase in bladder capacity was consistent. The long-time results are still unknown.

DONALD DE F. BAUER, M.D.
Coos Bay, Ore.

Minimal Amounts of X-Ray Exposure Causing Lens Opacities in the Human Eye. David G. Cogan and Knud K. Dreisler. *Arch. Ophthalmol.* 50: 30-34, July 1953.

The authors sought to examine as many persons as possible whose eyes had been exposed to a known amount of x-radiation and to determine thereby the least exposure which could cause an opacification of the lens that was visible with the ophthalmoscope or the slit-lamp biomicroscope. The 40 patients upon whom this report is based were irradiated for various reasons. In some the irradiation to the eye had been given as part of the effective treatment of lymphomas or basal-cell carcinoma of the ocular adnexa. For these patients the radiation was from a 200 or 1,200 kv. source. In another group of patients the eye was irradiated incidentally in the treatment of various dermatoses, shielding having been omitted either because use of the shield was impracticable or because the amount of radiation reaching the eye was thought to be of no consequence. The eye was not centered in the beam during these exposures, and the x-ray energy was only 100 kv.

Lens opacities were not found in those patients who had received 400 r (energies of 100 kv.) or less to the eye. Lens opacities of definitely radiation type were found in 1 of 3 patients who had received 600 r, in 1 patient who had received 800 r, and in 1 who had received 1,000 r. The time of onset of lens changes after the irradiation in these 3 patients was two and a half years for the first, between one and a half and four and a half for the second, and some time less than ten years for the third. In 2 patients who had received 2,400 r, mature cataracts had developed one year and four months and three years, respectively, after the irradiation.

While the threshold dose for the production of lens opacities with the energies ordinarily employed (100 to 200 kv.) appears to be of the order of 600 r, more observations are needed in the long-range follow-up of patients whose eyes have been exposed to x-rays in the dosage level of 400 to 1,000 r.

Radiation Cataract. William T. Ham, Jr. *Arch. Ophthalmol.* 50: 618-643, November 1953.

Under the heading "Ophthalmological Review" the author summarizes the status of knowledge of radiation cataract under the following headings: Cyclotron Victims; Atom Bomb Victims; Accidental Nuclear-Reaction Victims; Cataract from Exposure to X-Rays and Gamma Rays.

In February 1950, the Committee on Radiation Cataracts met to study the problem and to plan a definitive research program. One objective was to stimulate research on radiation dosimetry and to encourage comparisons among different laboratories so that the biological effects of ionizing radiations might

be determined in terms of a common denominator. The progress along these lines is described.

The remainder of the paper is devoted to a discussion of some of the experiments which have helped to clarify the problems faced by the Committee in 1950.

Protection from Roentgen Rays. Russell H. Morgan. *Am. J. M. Sc.* 226: 578-586, November 1953.

The article reviews the potential hazards of x-rays as used in diagnostic radiology. Four major anatomical areas may be affected: (a) the cutaneous system; (b) the hemopoietic system; (c) the reproductive system; (d) the osseous system (in children).

The changes which occur in the skin are localized and are usually the result of a single large exposure or multiple small exposures. The patient's skin is not likely to suffer from excessive single fluoroscopic exposure because properly operated equipment usually has an output of only about 6 r/minute. A recent survey (Sonnenblick *et al.*, J. Newark Beth Israel Hosp. 2: 153, 1951), however, has shown that many fluoroscopes in physicians' offices have outputs of 90 to 100 r/minute. The amount of accumulated radiation required to produce long-term cutaneous changes probably exceeds 5,000 r. The unprotected hand of the fluoroscopist, especially if placed in the direct beam, can easily accumulate this amount over a period of years.

The effects on the hematopoietic system may be immediate or delayed. The patient is not likely to suffer injury, because only a small part of the blood-forming organs are irradiated. The fluoroscopist, however, is exposed generally, and unless protective measures are employed there is a definite hazard in exposures over a long period of time. This includes the possibility of malignant changes in the blood-forming tissues. Because of the sensitivity of this system to excessive long-term irradiation, a maximum permissible exposure of 300 milliroentgen per week total-body irradiation has been empirically recommended.

The genetic effects of irradiation have been established in the fruitfly. The irradiation causes breakage and translocation of the chromosomes, with a consequent increase in mutations. The quantity of irradiation required to effect such changes in man is not known, but apparently amounts to several hundred roentgens. The accumulation of data of this type is obviously difficult, but from interpretation of available evidence there is now a belief that an individual should not receive more than 50 roentgens to the reproductive organs during his reproductive life (Howard *et al.*, *Brit. J. Radiol.* 25: 177, 1952).

Because of the susceptibility of growing ends of bones to irradiation, infants and children should be examined sparingly with x-rays. A cumulative dose of more than 100 r to the growing bone should be avoided.

The following suggestions are offered for minimizing the dangers of fluoroscopy: (a) use of a 3 mm. aluminum filter in the incident beam; (b) restriction of the size of the irradiated field to less than 8 × 10 inches; (c) maintenance of at least 18 inches tube-to-patient distance; (d) restriction of exposure time for any given patient to less than five minutes; (e) restriction of current to 5 ma. or less. Use of 0.5 mm. lead equivalent gloves and apron will attenuate 80 kv. radiation approximately 150 times. D. D. ROSENFELD, M.D.
Oakland, Calif.

Radiation Exposure Survey of X-Ray and Isotope Personnel. Charles K. Spalding, Egilda DeAmicis, and Russell F. Cowing. *Nucleonics* 11: 46-47, September 1953.

Since the time of an extensive radiation survey in 1940, the number of workers exposed to radiation has greatly increased. The radiation protection problem is further complicated by the increasing use of high energies of radiation.

A survey is described which was made of twelve x-ray departments during the three-year period of 1950-52; 275 workers were surveyed and over 12,000 films were employed. The number of films exceeding the permissible level was approximately 0.5 per cent. A slight increase in exposures greater than the permissible level was noted during this period. Most of the over-exposures were received by technicians who held patients being radiographed or who did not make proper use of the barriers provided with diagnostic machines. No exposures above the permissible figure were noted for either technicians or roentgenologists during therapy or fluoroscopic examination.

During the same three-year period 580 workers were surveyed in laboratories employing isotopes. About 29,000 films were employed, and only 23 of these showed exposures above permissible, primarily suffered during preparation of isotopes from initial stock shipments. It appears that the x-ray technician is more apt to receive over-exposure than the isotope technician.

Three tables.

JOHN S. LAUGHLIN, Ph.D.
Memorial Center, New York

Stray Radiation Levels in the Vicinity of Betatrons. Stanley H. Clark. *Nucleonics* 11: 38-39, September 1953.

The number of betatrons and synchrotrons in use in North America will soon reach sixty. Such accelerators are a source of stray x-rays and neutrons which constitute a definite radiation protection problem. The results of a survey of stray radiation around three industrial betatron installations are briefly described. The maximum energies of the betatrons were 15 mev, 50 mev, and 100 mev. The stray x-rays were detected with commercial ionization chambers of both the small thimble and large volume type. The chambers were imbedded in a sufficient amount of Lucite to maximize the ionization. These ionization chamber measurements are expressed in roentgens. Slow neutrons were measured by means of the radioactivity induced in rhodium foils. In the case of all these industrial betatron installations, the radiation levels outside the accelerator room in regions not occupied by personnel were below permissible levels. The actual radiation values in areas surrounding the accelerators are shown graphically.

The protection requirements are more stringent in the case of medical betatron installations, since the machine itself must be shielded in order to protect the patient.

Five figures.

JOHN S. LAUGHLIN, Ph.D.
Memorial Center, New York

Monitoring of Water for Fission-Product Contamination. W. R. Loosemore. *Nucleonics* 11: 36-40, October 1953.

An annular liquid beta counter is described for measuring water contamination with fission products in the range 5×10^{-4} to 0.5 microcuries/ml. if the

sample is diluted up to a maximum of ten times its original volume. This counter has an accuracy of ± 25 per cent. It is intended for use with a portable contamination meter (type 1092D) designed at the Atomic Energy Research Establishment, Harwell, England. The circuit employs cold-cathode tubes operating a meter with a full-scale reading equivalent to 350 counts/sec. The meter scale is roughly logarithmic, allowing measurements over a range 0.1-10 mr/hr.

Nine illustrations.

Economic Evaluation of Permanent Disposal of Radioactive Wastes. A. C. Herrington, R. G. Shaver, and C. W. Sorenson. *Nucleonics* 11: 34-37, September 1953.

Large quantities of radioactive waste are currently disposed of by evaporating to saturation and storage of the liquid concentrate in underground steel tanks. Such storage is costly and not permanent due to eventual corrosion of the tanks. Nine alternative methods are considered by the authors and relative cost analyses made. One of the more economical and satisfactory proposed methods is to pump radioactive waste into exhausted "dry" oil wells. With the assumption of 2,000 gallons of waste per day at 20 curies per liter and 100 miles transportation from plant to well, a cost of about 59 cents per gallon of waste was estimated. Though this method meets all technical requirements as a permanent storage method without danger of contamination, it is not generally applicable in most cases.

The methods discussed which are most generally available involve the incorporation of the concentrated liquid waste into concrete. Experiments indicate that about 5 per cent of the radioactivity is leached out fairly rapidly, but that the remainder remains indefinitely in the concrete. Land burial of radioactive waste incorporated in unleached concrete is feasible if the burial site has a sufficiently low rainfall to prevent ground water contamination. Calculations on the basis of a burial site in Death Valley yielded a cost of 96 cents per gallon of waste.

The use of unleached concrete is also feasible for burial at sea. This method is particularly appropriate for plants located near navigable water and results in a cost of about 60 cents per gallon. The use of pre-leached radioactive concrete would permit nearby land burial and minimize transportation costs. This is the most economical method and is estimated to cost about 58 cents per gallon.

Other methods considered involve ceramic adsorption, fusion with sulfur, coprecipitation of waste with flocculent precipitates and electrolytic deposition. These are not as satisfactory technically as land burial of pre-leached radioactive concrete.

One table.

JOHN S. LAUGHLIN, Ph.D.
Memorial Center, New York

Radiophotoluminescence Dosimetry System of the U. S. Navy. James H. Schulman, William Shurcliff, Robert J. Ginther, and Frank H. Attix. *Nucleonics* 11: 52-56, October 1953.

The advent of nuclear weapons has created a need for small, inexpensive, and rugged high-range gamma-ray dosimeters for general distribution to military and civilian personnel. This need is satisfied to a con-

siderable degree by the DT-60/PD personnel dosimeter developed under the auspices of the U. S. Navy Bureau of Ships, employing the radiophotoluminescence system of dosimetry. This dosimeter, utilizing Ag-activated phosphate glass, has a range of from 10 r to at least 600 r. Response is linear and independent of dose rate up to at least 170 r/min. Energy dependence is diminished by lead filters.

Twelve illustrations.

Experimental Radiation Cataract. III. Further Experimental Studies on X-Ray and Neutron Irradiation of the Lens. David G. Cogan, David D. Donaldson, John L. Goff, and Elizabeth Graves. *Arch. Ophthalm.* 50: 597-602, November 1953.

The present paper is one of a series (see *Arch. Ophthalm.* 45: 508, 1951; 47: 584, 1952. *Abst. in Radiology* 58: 634, 1952; 60: 480, 1953) describing the ocular events in rabbit eyes following exposure to x-rays and neutrons.

X-rays: It was previously established that exposure to an x-ray dose of 250 r (1.2 mev) was sufficient to induce granular opacities, preferentially along the posterior suture line of the lens. One rabbit so treated was followed for a total of 760 days and no progress of the opacity over that noted a few weeks after its first appearance was observed. In the present experiment exposure at this and at lower dose levels was repeated.

Pigmented rabbits were exposed to x-rays (1.2 mev) in dose ranges of 75, 150, and 250 r. One eye only of each animal was irradiated, the other eye serving as a control. Ophthalmoscopic examination of the eyes was carried out approximately every fifty days. The observation period following irradiation was eighteen months.

Neutrons: In the previously reported study it was noted that in rabbits exposed to as low a dose as 1×10^9 neutrons/cm.² (of degraded fission neutron energy) lens changes ascribable to radiation developed. Of this series, 8 rabbits which had received doses ranging from 4×10^8 to 1×10^9 /cm.² had been followed at the time of present report for a total of twenty-eight months. The opacities remained stationary, as punctate dots, situated preferentially along the posterior suture line in 4 eyes, while they showed slight evidence of increase, but never amounting to more than punctate dots in the other 4. For the present study, dose levels were selected which would overlap the above but extend much further down in the low-dose range.

Thirty rabbits were exposed to neutrons of degraded fission energy. Dosage levels of exposure were selected to extend from 4×10^8 to 1×10^9 neutrons/cm.² and one eye only of each animal received the measured amount of radiation. Groups of 2 to 3 rabbits were exposed to serial doses distributed so that each group received approximately one-half the dose of the preceding group. The eyes were examined ophthalmoscopically about once a month for eighteen months.

Conclusions: The authors' conclusions are as follows: Lens changes resulting from irradiation do not have a critical dose level. The lower the dose the less apparent are the changes, with an end-point depending chiefly on the method of examination. The term cataract is arbitrarily defined as a lens opacity that would be expected to result in some impairment of vision if it were to be present in the human lens. This results in the rabbit lens with an irradiation of the

following types and amounts: x-rays, 500 r (1.2 mev); neutrons, 8.4×10^8 particles/cm.² (14 mev), or 3.2×10^{10} particles/cm.² (fission energy). With decreasing dosage, the effects of irradiation of the lens decrease less rapidly with neutrons than with x-rays.

The energy released in the lens at the cataractogenic level, expressed as ergs per cubic centimeter, is 46.5×10^3 in the case of x-rays (1.2 mev) and 4.2×10^4 and 5.4×10^3 in the case of neutrons of 14 mev and fission energy, respectively. Thus, although the energy released is of the same order of magnitude at the cataractogenic level in the case of the neutrons of two widely different energies, it is less by a factor of 10 than in the case of x-rays. With equivalent ionization in tissue, neutrons are much more productive of cataract than are x-rays.

Lens opacities in the rabbit resulting from either 250 r (1.2 mev) or 1×10^9 neutrons/cm.² (0.3 mev), or less, characteristically reached a plateau of density and then either remained stationary or regressed.

Experimental Production of Radiation Cataracts by Fast Neutrons. Campbell Moses, Jay G. Linn, Jr., and Alexander J. Allen. *Arch. Ophthalm.* 50: 609-612, November 1953.

The object of the present investigation was to determine the fast neutron dose in dogs which, after a single exposure, would result in the development of lenticular cataracts, and to determine whether a small neutron dose repeated at frequent intervals had a greater or less tendency to produce cataracts than a single larger dose. The studies have been in progress for three years, and the authors now report their findings during this preliminary period.

Anesthetized dogs were rigidly positioned with the left eye closest to a directional beam of neutrons derived from a collimated 16 mev external deuteron beam striking a beryllium target 8 ft. from the cyclotron. The neutrons were filtered through 0.03 in. of cadmium and 1.0 in. of lead. This decreased the gamma-ray exposure to less than one-thousandth the neutron dose. These neutrons were approximately 6 to 8 mev. The cadmium, lead, and 8 in. of concrete block shielded the body of the animal. Because of the directional nature of the neutron exposure, the eye closest to the target received a much larger neutron exposure than did the body of the animal.

One exposure to a collimated beam of 6- to 8-mev neutrons of 60 to 150 N failed to produce clinically evident lenticular cataracts over a two-year period of observation. In puppies and young dogs some vacuolation of the lens may result from this dose, but this is not followed by cataract formation. The administration of 810 to 900 N resulted in cataract formation in 60 to 75 per cent of the eyes of adult dogs. A dose of 1,500 N produced complete necrosis of the globe, orbit, and surrounding structures three to four months after exposure.

In 16 rabbits a total neutron whole-body exposure of 52.7 to 83.7 N administered at weekly intervals in a dose of 3.1 N for seventeen to twenty-seven weeks failed to produce cataracts in a four- to twelve-month follow-up period after cessation of exposure. A single collimated neutron dose of from 33 to 100 N produced definite cataracts in two to five months in the 3 rabbits exposed.

Two tables.

Effects of Beta Irradiation on the Rabbit Lens. Ludwig von Sallmann, Carmen M. Munoz, and Anne Drungis. *Arch. Ophth.* 50: 727-736, December 1953.

By means of a Sr^{90} applicator, the limbal areas of rabbits were irradiated with beta particles at dosage levels of 2,000, 5,000, 10,000, and 20,000 rep. Cytologic examination of the lens epithelium of 53 animals showed that radiation-induced damage to the nuclei of the germinative zone was limited to the sector closest to the irradiated part of the limbus. The extent of the cell injury depended on the dose. The observations confirm those of previous experimental studies in which extensive early microscopic lesions in the lens epithelium were invariably followed by cataractous changes (*Arch. Ophth.* 45: 149, 1951. *Abst. in Radiology* 57: 925, 1951).

In 5 of 6 animals lens opacities developed within ten weeks after irradiation with 5,000 rep or more. These opacities extended to and included the posterior pole of the lens. Despite the beta-radiation-induced damage to the lens, the area of the cornea which was in direct contact with the applicator was free of biomicroscopically visible lesions.

X-ray treatment of rabbit eyes in doses of 100, 500, and 1,500 r resulted in damage to the equatorial cells comparable to the changes induced by beta irradiation when the different conditions of the two experimental procedures were taken into consideration.

In view of the short distance of the limbus from the equator of the human lens, and the high radiosensitivity of the germinative epithelium of the lens, it is recommended that extreme caution be exercised when the limbal area of the cornea is to be subjected to beta irradiation in relatively high doses.

Five illustrations; 4 tables.

Roentgen Rays and Wound Healing. II. Fractionated Irradiation. An Experimental Study. James J. Nickson, Walter Lawrence, Jr., Irene Rachwalsky, and Ella Tyree. *Surgery* 34: 859-862, November 1953.

In an earlier paper (*Surgery* 33: 376, 1953. *Abst. in Radiology* 62: 162, 1954), the authors discussed the effect of a single dose of x-ray irradiation on the healing of subsequent wounds experimentally produced. In the study reported in this paper, fractionated irradiation was used instead of the single dose method.

Female white Wistar rats, weighing between 200 and 250 gm., were anesthetized with Pentothal Sodium administered in the tail vein. In the earlier studies, irradiation was given to an abdominal field measuring 3×2 cm., with 100 kv., 6 ma., 1 mm. Al filter and h.v.l. 1.8 mm. Al, at a target-skin distance of 15 cm. for a dose of 2,000 r (air). The same physical factors were used for this second experiment except that the irradiation was protracted, four doses of 500 r (air) each being given at intervals of two days. Control animals were anesthetized in the same manner as the irradiated animals. Wounds were made, under sterile technic, three weeks following irradiation in one group, and twelve weeks after irradiation in a second group. Animals were sacrificed at intervals of four to twenty days.

The group of rats in which the fractionated irradiation preceded the standard incision by three weeks showed a slower rate of healing, as measured by tensile strength, than the control animals. The group of

animals in which the irradiation preceded the surgery by twelve weeks also showed delayed healing; the maximum strength range was reached between twelve and fifteen days. In this group there was an increase in the rate of wound healing compared with the three-week group, but the difference was not great.

The wound healing curves for the studies using fractionated and single dose irradiation show a remarkable similarity. The increase in the irradiation-surgery interval from three to twelve weeks produced a definite but slight improvement in rate of healing. In both instances, the final wound strength was comparable to that of the controls at twenty days.

The authors conclude that there is no real reason to suspect a difference in the effect on wound healing when preoperative irradiation is given in a fractionated manner rather than in a single dose. From these studies it seems that there would be little practical advantage in waiting more than three weeks after a course of irradiation to carry out a surgical procedure through a treatment area.

One graph; 1 table. C. E. DUSENBERG, M.D.
Palo Alto, Calif.

The Frequency of Ovarian Tumours and of Estrus in Mice Treated with Roentgen Radiation and Hormones. Stig Kullander. *Acta radiol.* 40: 479-492, November 1953.

The purpose of the study reported here was to check the effect of roentgen irradiation and to elucidate any role played by hormonal factors. Following irradiation, some mice were treated with estrogen to counteract hyperproduction of hypophyseal gonadotrophin, while others received gonadotrophin in order to enhance the supposed gonadatrophic tumor-producing factor. The effect of irradiation and hormones was studied in vaginal smears.

Two series of animals were used. Series 1 included 84 mice as controls and 299 irradiated, 150 over the entire body and 149 with the head shielded. The skin dose was 335 to 505 r, with an average of 415 r. The 150 animals irradiated over the entire body were divided into three subgroups. The first received no hormones, while the second received injections of estrogen, and the remainder injections of chorionic gonadotrophin. The animals which were irradiated with the head protected were likewise divided into three groups, similarly treated.

In Series 2, 9 mice were used as controls and 41 were totally irradiated, with an average skin dose of 170 r. Of the irradiated mice, 9 received injections of estrogen and 9 received chorionic gonadotrophin.

In the group which received 400 r (or thereabouts) there was no definite difference in the frequency of ovarian tumors and mammary carcinoma as compared with the controls, but the incidence of pulmonary tumor was increased. In this respect irradiation of the entire animal had the same effect as irradiation with the hypophysis protected by a lead screen. The administration of gonadatrophic hormone to irradiated animals was followed by increased incidence of pulmonary tumor at an early age. Administration of estrogenic hormones to irradiated animals resulted in a high mortality. The animals that were irradiated with 170 r became sterile and the frequency of estrus from the tenth week to the tenth month after irradiation was low. Gonadotrophin increased the frequency of estrus, and

histologic examination showed a tendency to increased activity in the ovaries of the animals thus treated.

Twelve illustrations; 2 tables.

A. WILSON BROWN, M.D.
Shreveport, La.

A Study on the Protective Action of 2,3-Dimercapto-propanol (BAL) on Radiation-Induced Changes in the Ovarian Follicles in Mice. Erik Odeblad. *Acta radiol.* 40: 493-499, November 1953.

A total of 146 adult healthy female virgin mice were divided into eleven groups. One group served as an untreated control; three groups received injections of arachis oil either with or without BAL; other groups were irradiated either externally by roentgen rays (400 r and 600 r) or internally by P^{32} , following injection of oil or oil and BAL. Four days after injection of P^{32} and four to six days after roentgen irradiation the animals were killed and the ovaries were removed for study. The follicle diameters were measured and autoradiographs were obtained.

From the results of these studies, it was evident that BAL given repeatedly during the course of internal irradiation afforded some protection (about 40 per cent) against ovarian changes due to P^{32} . In the case of roentgen rays in comparable dosage, protection to a similar degree was not found.

The most important implication of this investigation is that a specific organ has been proved to be protected during continuous irradiation over several days. This finding may be practically utilized in cases of overdosage of radioisotopes given internally and of accidental poisoning by their ingestion.

Two autoradiographs; 2 tables.

A. WILSON BROWN, M.D.
Shreveport, La.

Age, Strain and Species Factors in Post-Irradiation Protection by Spleen Homogenates. Leonard J. Cole and Marie E. Ellis. *Am. J. Physiol.* 173: 487-494, June 1953.

The authors describe an investigation of the phenomenon of post-irradiation protection by mouse-spleen homogenates, and its modification by age, strain, and species factors. Their data are based on a series of several hundred mice exposed to whole-body irradiation, with the following factors: 250 kv.p.; 15 ma.; filter, 0.5 mm. Cu plus 1 mm. Al; h.v.l., 1.5 mm. Cu; skin-to-target distance, 100 cm.; dose-rate, approximately 25 r per minute, as measured in air with a Victoreen r meter.

Previous findings on post-irradiation protection by spleen homogenates have been extended to a large series of animals, including mice exposed to 850 r. As little as 28 mg. of spleen-tissue homogenate from one-week-old mice afforded radiation protection, while at least 100 mg. of adult spleen-tissue homogenate was required for comparable protection. A converse age-effect was observed in the recipient irradiated mice: the same spleen-homogenate preparations which gave protection against mortality when administered to adult mice (ten and eleven weeks old) exposed to 750 r failed to protect irradiated five-week-old mice.

Spleen homogenate was effective in decreasing mortality in splenectomized, irradiated mice.

Homogenates of spleens from LA_{f_2} mice afforded little or no protection when injected into irradiated

LA_{f_1} mice; whereas homogenates prepared from the pooled spleens of LA_{f_3} , LA_{f_4} , and LA_{f_5} mice were effective in decreasing the mortality of irradiated LA_{f_1} mice.

A small but consistent degree of protection was observed in irradiated rats receiving rat-spleen homogenate injection. It was suggested that radiation injury to the intestine may be a complicating and limiting factor in radiation recovery in this animal.

Three charts; 4 tables.

A Study of Antigen Localization and Degradation and the Histologic Reaction in the Spleen of Normal, X-Irradiated, and Spleen-Shielded Rats. Frank W. Fitch, Patricia Barker, Kathryn H. Soules, and Robert W. Wissler. *J. Lab. & Clin. Med.* 42: 598-620, October 1953.

Three experiments are reported, representing a study of certain traceable steps of antigen localization and degradation and of antibody formation in the normal, irradiated, and spleen-shielded rat with particular reference to the spleen. In each of the experiments, a similar plan was followed. In Experiment I, 500 r total-body irradiation was administered to one group of rats, while another group of animals was retained as a control. Both groups were injected intravenously twenty-four hours later with a standard dose of killed *Salmonella typhi* organisms, labeled with I^{131} , and with a standard dose of sheep erythrocytes. Experiment II differed from Experiment I in that NaI^{131} and non-iodinated *Salmonella typhi* were injected separately in order that the fate of unattached NaI^{131} might be compared with that of I^{131} -labeled vaccine. Experiment III was similar to Experiment I, except that rats with lead shielding of the spleen during irradiation were also studied. Blood stream clearance, tissue distribution, and excretion of I^{131} were determined. The histologic reaction to antigenic stimulation was followed at intervals of one, four, and six days after antigen injection.

There was no difference in rate of phagocytosis, tissue localization, or rate of disappearance of antigen from the tissues in the three groups of animals.

Radioautographs showed localization of antigen in the red pulp of the spleen, in the mantle of cells around the Malpighian corpuscles, and focally in the pulp.

The histologic reaction of the spleen following antigenic stimulation in normal and spleen-shielded animals consisted of hyperplasia of the red pulp and increase in pyronin staining of the cells. This pattern was not observed in animals irradiated without spleen shielding.

The significance of these findings with regard to the mechanism of irradiation damage to antibody formation is discussed.

Sixteen photomicrographs; 3 charts; 6 tables.

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Prevention of Irradiation-Induced Lymphoid Tumors in C57BL Mice by Spleen Protection. Egon Lorenz, Charles C. Congdon, and Delta Uphoff. *J. Nat. Cancer Inst.* 14: 291-301, October 1953.

One hundred and eighty-one male and female mice of the C57BL strain were studied in an attempt to determine if prolonged depression of hematopoietic tissues play a role in induction of lymphoid tumors. Group I (61 mice) served as an irradiated control group without

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spleen protection, although the spleen was exteriorized. Animals of this group received 225 r, total-body irradiation, once a week for four weeks. Group II (61 mice) received the same irradiation as Group I but the exteriorized spleen was protected with lead. Group III (59 mice) received one exposure of 900 r, total-body irradiation, with the spleen protected.

Analysis of the results of these three experiments led to the following conclusions: (1) Spleen protection significantly inhibits induction of lymphoid tumors by irradiation. Tumor incidence in Group I was 68 per cent; in Group II it was only 2 per cent, and in Group III there were no tumors. (2) Spleen protection inhibits depression of the leukocyte count. (3) Spleen protection prevents cellular depletion of the sternal marrow.

The prevention of lymphoid tumor induction through spleen shielding during irradiation is related to an unknown factor in the bone-marrow or in the spleen, or both, which stimulates rapid recovery of lymphoid structures. Prolonged bone-marrow depression and the concomitant reduction of lymphocytes in lymphoid structures may be a major factor in the induction of lymphoid tumors in these mice.

Seven illustrations; 1 table.

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Influence of Bone Marrow Injections on Involution and Neoplasia of Mouse Thymus After Systemic Irradiation. Henry S. Kaplan, Mary B. Brown, and Janice Paull. *J. Nat. Cancer Inst.* 14: 303-316, October 1953.

A series of five experiments performed on C57BL mice, a strain which is highly susceptible to lymphoid tumors of thymic origin after total-body irradiation but almost completely refractory to such tumor development after local irradiation over the thymic area, tested the effects of bone-marrow cell suspensions on thymic regeneration and tumor incidence. These experiments indicated that: (1) The active principle of marrow which is responsible for thymic regeneration is destroyed by preirradiation of donor mice. (2) Intravenous injection of bone-marrow accelerates thymic regeneration but not as effectively as thigh shielding of the irradiated mice. (3) The active principle of the bone marrow belongs to the cell and is readily denatured upon removal from its living cellular environment. (4) Injection of normal marrow into preirradiated mice is not effective in promoting thymic recovery if injection is delayed more than several days after irradiation. (5) Shielding of the spleen during irradiation promotes thymic regeneration in the same way as thigh-shielding or bone-marrow injection. (6) Intravenous injection of bone marrow has a distinct inhibitory influence on the development of lymphoid tumors, but this effect is significantly less than that of thigh-shielding. The difference is probably due to the immediate availability of the active principle from autologous marrow cells of the shielded femur.

It is significant that lymphoid tumor development can be blocked by a mechanism that does not modify the degree of initial radiation injury suffered by the tissues in which the tumors develop. Thus, the initial radiation injury, *per se*, is not wholly responsible for tumor induction, but merely sets in motion a train of events which are reversible during a finite period of

time after irradiation. This reversibility is dependent upon the availability of an active principle in bone-marrow cells and cells in the spleen which is readily denatured.

Four illustrations; 5 tables.

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The Effect of Homologous Bone Marrow Emulsion on Rabbits after Total Body Irradiation. Martin F. Hilfinger, Jr., J. Howard Ferguson, and Paul A. Riemen-schneider. *J. Lab. & Clin. Med.* 42: 581-591, October 1953.

This report deals principally with the effect of bone marrow emulsion and related substances administered intravenously on the survival of rabbits after total-body irradiation.

One hundred and eighty white New Zealand rabbits, equally divided between males and females, received irradiation to both sides of the body with 600 r (in air), for a total-body dose of 1,200 r (in air). The physical factors were 200 kv.p., 15 ma., with added filtration of 0.5 mm. Cu and 1.0 mm. Al, h.v.l. 1.2 mm. Cu; dose rate 20 r per minute; distance 50 cm. The animals were divided into 6 groups: Group I received 1,200 r of total-body irradiation only; Group II received homologous serum three days after irradiation; Groups III, IV, and V received homologous bone marrow emulsion within one hour after irradiation, one day after irradiation and three days after irradiation, respectively; Group VI received homologous marrow emulsion supernate three days after irradiation. In Group I, 91.7 per cent of the rabbits irradiated died within thirty days. One-half of these died within a twelve-hour period after irradiation, while most of the remainder lived eleven or twelve days. There was no definite correlation between death and the level of circulating neutrophils. The 30-day survival for the animals in Group II was not significantly increased over that of the control animals living at least three days after exposure. There was no indication that treatment with homologous bone marrow emulsion within one hour after irradiation (Group III) altered the expected mortality to any significant degree. Treatment one day after irradiation (Group IV) increased survival only slightly over that in Group III. The highest survival rate (60 per cent) was obtained with administration of homologous bone marrow emulsion three days after irradiation (Group V). As in the control animals (Group I), the authors were unable to ascribe the cause of death in these treated animals to any specific organic lesion. Animals receiving marrow emulsion supernate three days after irradiation (Group VI) showed a 53.3 per cent survival, which closely approximates that seen in animals receiving the homologous bone marrow emulsion. This supernate was essentially cell-free.

No factors in the survival indicated that sex played a part, nor did survival bear any relationship to the pre-irradiation weight of the animal, larger animals doing no better than smaller ones. There was no significant difference between the animals surviving or dying in regard to the number of cells injected.

The reason for the relative ineffectiveness of bone marrow one hour and twenty-four hours after exposure is not clear. The authors point out, however, that in rabbits profound shock is present after total-body

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irradiation and this undoubtedly is the cause for the large number of deaths within the first twenty-four hours. No significant differences were observed in the daily peripheral blood counts or marrow of the irradiated animals, regardless of whether they were treated or not, and regardless of whether they died or survived.

The authors suggest, in conclusion, that the beneficial effect of bone marrow emulsion does not depend upon growth of the injected cells in the irradiated rabbit, but rather upon the non-cellular fraction of the marrow emulsion.

Six graphs; 4 tables. C. E. DUSENBERG, M.D.
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Effect of Phenylhydrazine and X-Irradiation on Red Cell Destruction and Serum Iron Concentration. Alfred Chanutin, Elizabeth A. Lentz, and Stephan Ludewig. *Am. J. Physiol.* 173: 474-480, June 1953.

The total hemoglobin of blood and the iron concentration of serum were determined in intact and splenectomized rats receiving intravenous injections of phenylhydrazine and total-body x-irradiation. The findings were as follows:

Single injections of small amounts of phenylhydrazine (2.5-4.0 mg./kg. body weight) do not appear to affect the hemoglobin concentration. After treatment with a combination of phenylhydrazine and a non-lethal dose of total-body irradiation (500 r) [physical factors not given in present paper], different degrees of anemia can be produced in the intact rat by varying the amount of phenylhydrazine administered. The same treatment in splenectomized rats fails to produce the anemia observed in the intact animal.

Small doses of phenylhydrazine (10-40 mg./kg.) cause a temporary increase in serum iron in intact and splenectomized animals. A pronounced and prolonged hyperferremia results from the treatment with phenylhydrazine plus x-irradiation in intact rats. This effect is much less pronounced in splenectomized animals.

The serum iron concentration is markedly elevated in rats irradiated six days following an injection of phenylhydrazine.

The possible significance of these results is discussed. Three charts; 5 tables.

Effect of Phenylhydrazine and X-Irradiation on Iron Deposition in Tissues of Intact and Splenectomized Rats. Alfred Chanutin, Stephan Ludewig, and Elizabeth A. Lentz. *Am. J. Physiol.* 173: 481-486, June 1953.

This paper is concerned with (a) the total and ferritin iron content of the liver and (b) the distribution of Fe^{59} of transfused labeled red cells in the blood, liver, and spleen of intact and splenectomized rats after treatment with phenylhydrazine and x-irradiation.

The deposition of iron in the livers of intact rats

was found to be appreciably increased after subjecting the animals to treatment with a combination of small doses of phenylhydrazine (10 mg./kg.) and x-irradiation (500 r). Phenylhydrazine alone had no effect on iron storage in the liver, while x-irradiation alone was responsible for a moderate increase in deposition.

In the splenectomized animals, the values for liver iron were markedly increased after combined phenylhydrazine and irradiation.

The relationship of ferritin to total iron in the liver was not appreciably changed in the various groups treated with phenylhydrazine, x-irradiation, and a combination of the two.

Studies with transfused radioiron (Fe^{59})-labeled red cells indicated that the spleen is the chief iron storage site during the period of red cell destruction. In the absence of the spleen, the liver is capable of storing comparatively large amounts of iron.

The red cells of the splenectomized animals were found to be more resistant to destruction than those of intact animals.

Four tables.

Proteolytic Enzyme Studies in Irradiated Rabbits.

Nannie K. M. de Leeuw, Claude-Starr Wright, and Joseph L. Morton. *J. Lab. & Clin. Med.* 42: 592-597, October 1953.

Thrombocytopenia and a humoral coagulation defect as factors in the hemorrhagic phenomena of the post-irradiation syndrome have been frequently investigated, but the fibrinolytic phenomena have received little attention. The authors have studied the fibrinolytic mechanism by (1) observing the spontaneous lysis of clots and (2) determining the serum profibrinolysin and (3) antitrypsin activity.

Ten rabbits weighing from three to five pounds were given 900 r total-body irradiation (250 kv.). Each animal was irradiated separately in a cylinder of four thicknesses of 1 mm. Pliafilm, being rotated at 1.3 r.p.m. in an upright position. The focal distance was 1 meter; filtration 0.5 mm. Cu plus 1 mm. Al. Blood samples were obtained every other day by cardiac puncture. Three of the rabbits died immediately after irradiation. Two with terminal thrombocytopenia died of traumatic hemopericardium without other signs of bleeding shortly after cardiac puncture, on the sixth and seventh post-irradiation days. The other rabbits showed neither thrombocytopenia nor gross hemorrhages at autopsy.

In all of the 7 rabbits available for post-irradiation study, the serum profibrinolysin and antitrypsin was found to be increased. Spontaneous rapid lysis of clots was not observed. Thus, in irradiated rabbits a rise in serum profibrinolysin and antitrypsin may occur in the absence of spontaneous hemorrhage or spontaneous lysis.

Two charts; 2 tables.

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